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" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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THE FIRST VOLUME OF THE PUBLICATIONS OF THE "CHALLENGER"

FOUR years have elapsed since the *Challenger* returned from her famous cruise, and the scientific world has been looking, of late perhaps somewhat impatiently, for the first instalment of the long series of volumes which is to embody the results of the investigations of the best-equipped voyagers who ever left the shores of England for the purpose of enlarging the bounds of natural knowledge.

But this is one of the many cases in which impatience is more natural than justifiable. In the "General Introduction" with which Sir Wyville Thomson prefaces the "Reports" which are to appear in the first volume of the great work for which he is responsible, he mentions that the zoological specimens collected and preserved in alcohol during the voyage filled 2270 large glass jars, 1749 smaller bottles, 1860 glass tubes, and 176 tin cases; while 22 casks and 180 tin cases held objects preserved in other ways.

In dealing with this vast mass of material, Sir Wyville Thomson justly considered it to be his duty to obtain, as far as it was practicable so to do, the co-operation of the best specialists in every department, irrespective of nationality; and it is gratifying to find that, in reply to his invitations, many foreign men of science of great distinction have willingly associated themselves with a strong corps of English workers. This matter being arranged, the specimens had to be distributed to their destinations; and the several workers, rarely men of much leisure, found themselves embarked in months or years of critical and laborious investigation. Along with this went the slow process of writing out the results, and the still slower of executing the illustrations with due care, all of which had to be finished before the printer could begin his operations.

To those who are familiar with the amount of expenditure of trouble and time which all these processes mean, it will seem no small matter that seven treatises, illustrated by a large number of admirably executed plates, are now ready for distribution, and that three more volumes of no less magnitude are to be issued before the end of the year; so that the fifteen or sixteen volumes of which the whole work is to consist may reasonably be expected to be in the hands of the public by 1884.

The "Zoological Reports," as these separate treatises upon each group of specimens are termed, are printed as they are completed, and are to be issued, without reference to the order which they will eventually occupy, as soon as sufficient matter to form a volume is ready. Each memoir will be separately paged, and will have its own legend for reference. This arrangement has been adopted in order that working naturalists may have access to the "Reports" as early as practicable, and that the multiplication of synonyms by the simultaneous publication of species by different observers may be avoided. With this object in view, it would perhaps have been even better to have issued every "Report" as it was ready; but it may be that there are practical difficulties in the way of the adoption of this course.

The present writer, though a fairly swift reader, does not profess to have perused the seven elaborate memoirs now presented on behalf of the *Challenger;* nor if he had does he lay claim to that zoological omniscience which would justify him in criticising them in detail. But as Mr. Brady deals with the Ostracoda, Mr. Davidson with the Brachiopoda, Dr. Günther with the Shore Fishes, Prof. Kölliker with the Pennatulidæ, Mr. Moseley with those groups of Corals which he has made his special study, Mr. Parker with the Development of the Chelonian Skull, and Prof. Turner with the Cetacea, it is questionable if any extant finite knowledge is likely to enable its possessor to say anything more or better than they have said on these respective topics. And, as has been already remarked, there can be no sort of doubt as to the artistic excellence of the 122 quarto plates which illustrate and adorn the text.

Sir Wyville Thomson's "General Introduction," however, is extremely readable both in size and in substance, and may be commended to that patient omnivore, the General Reader, who will find in its earlier pages a readily intelligible account of the fittings and appliances of the *Challenger*, and of the means by which the greatest depths of the sea have been made to yield some, at any

rate, of the secrets of the busy life which, contrary to all the beliefs of the naturalists of a past generation, blindly toils and moils in the darkness and cold of the marine abysses.

The latter half of the "Introduction" will be no less interesting to the biologist, since it embodies the general conclusions at which the scientific director of the Expedition has arrived, in a dissertation on the nature and distribution of the fauna of the deep sea.

Sir W. Thomson considers that the most "prominent and remarkable biological result" of the four years' work of the *Challenger* is the final establishment of the fact "that the distribution of living beings has no depth-limit, but that animals of all the marine invertebrate classes, and probably fishes also, exist over the whole of the floor of the ocean." As to the exact nature of this deep-sea fauna at the greatest depths, he speaks with some hesitation; but, at about 2000 fathoms, the list given on pages 36 and 37 proves that there is a large and a varied assemblage of forms of life. Upwards, this characteristic deep-sea fauna extends to about 600 fathoms, and is richest between this depth and 1000 or 1200 fathoms. Around all coasts, in temperate regions, the local shore forms, which occupy successive zones of depth as, on land, they characterise zones of height, gradually die out towards the 200-fathom line. Nor is there any close relation between the abyssal and the shore faunæ of any given latitude or longitude—on the contrary, the abyssal fauna is singularly uniform and appears "to have been derived from a genetic source different from that of the shore fauna." In fact, Sir Wyville Thomson appositely compares the abyssal ocean—that is the sea everywhere below 200 fathoms or thereabouts—to a world-wide lake of comparatively still water, which, in its deeper parts, is very cold, its temperature neither rising nor falling appreciably beyond the average of 35° F.

Thus there is a certain parallel between land and sea distribution, inasmuch as all Alpine floræ present marked analogies with circumpolar floræ. The cold land is discontinuous, whence it presents, as it were, islands of analogous population all over the world; while the cold water being continuous, the continuity in its population is correspondingly unbroken. But the uniformity and invariability of conditions is far more complete in the abyssal lake than on the mountain-tops; and the homogeneity of the population harmonises with that of the medium in which it lives.

Sir Wyville Thomson draws attention to the fact that this widespread abyssal fauna

". . . . has a relation to the deep-water fauna of the Oolite, the Chalk, and the Tertiary formations, so close that it is difficult to suppose it in the main other than the same fauna which has been subjected to a slow and continuous change under slightly varying circumstances according to some law, of the nature of which we have not as yet the remotest knowledge" (p. 49).

"There is every reason to believe that the existing physical conditions of this area date from a very remote period, and that the present fauna of the deep sea may be regarded as directly descended from faunæ which have necessarily occupied the same deep sea. . . . That the present abyssal fauna is the result of progressive change there can be no room for doubt; but it would seem that in this case, the progress has been extremely slow, and that it has been brought about almost in the absence of those causes—such as minor and local oscillations of the crust of the earth producing barriers and affecting climate—on which we are most inclined to depend for the modification of faunæ. The discovery of the abyssal fauna, accordingly, seems to have given us an opportunity of studying a fauna of extreme antiquity, which has arrived at its present condition by a slow process of evolution from which all causes of rapid change have been eliminated" (p. 50).

That the deep-sea fauna presents us with many forms which are the dried and but little modified descendants of Tertiary and Mesozoic species is a proposition which few who attend to the evidence will be disposed to deny. But I may venture to express some doubt, whether it may not be well to keep a conclusion of such gravity and so well founded, apart from views respecting the absence of "minor local oscillations of the crust of the earth" in the area of the present great ocean basins, which Sir Wyville Thomson expresses more fully elsewhere.

"There seems to be sufficient evidence that all changes of level since the close of the Palæozoic period are in direct relation to the present coast lines.

"There does not seem to be a shadow of reason for supposing that the gently undulating plains, extending for over a hundred million of square miles, at a depth of 2500 fathoms beneath the surface of the sea, and presenting, like the land, their local areas of secular elevation and depression, and their centres of more active volcanic disturbance were *ever* raised, at all events in mass, above the level of the sea; such an arrangement, indeed, is inconceivable" (p. 46).

I must plead ignorance of the "sufficient evidence" to which Sir Wyville Thomson refers; in fact, I should have thought that the sufficient evidence lay in the other direction. Surely there is evidence enough and to spare that the Cretaceous sea, inhabited by various forms, some of whose descendants Sir W. Thomson, as I believe justly, recognises in the present deep-sea fauna, once extended from Britain over the greater part of Central and Southern Europe, North Africa, and Western Asia to the Himalayas. In what possible sense can the change of level which has made dry land and sometimes mountain masses of nine-tenths of this vast area be said to be "in direct relation to the present existing coast lines"?

That the abyssal plains were ever all elevated, at once, is certainly so improbable that it may justly be termed inconceivable; but there is nothing, so far as I am aware, in the biological or geological evidence at present accessible, to render untenable the hypothesis that an area of the mid-Atlantic or of the Pacific sea-bed as big as Europe should have been upheaved as high as Mont Blanc and have subsided again any time since the Palæozoic epoch, if there were any grounds for entertaining it.

In concluding the "Introduction" Sir Wyville Thomson expresses "a strong personal impression" on two points. The one is that the study of the abyssal fauna lends a powerful support to the doctrine of evolution. The other is, that "the character of the abyssal fauna refuses to give the least support to the theory which refers the evolution of species to extreme variation guided only by natural selection." But the grounds assigned for the latter opinion are hardly so cogent as might be desirable.

"Species are just as distinctly marked in the abyssal

fauna as elsewhere, each species varying within its definite range as each species appears to have varied at all times past and present" (p. 50).

Exactly so; the abyssal species are like species elsewhere. The difficulties in the way of the application of the evolution of species by variation and selection therefore in this case cannot be greater than elewhere. In fact, from the sentences which end the "Introduction" it seems doubtful whether they are not less than in many other cases.

"Transition forms linking species so closely as to cause a doubt as to their limit are rarely met with. There is usually no difficulty in telling what a thing is" (p. 50).

Hence it appears that the study of the abyssal fauna has satisfied Sir Wyville Thomson that transitional forms are sometimes met with; and that, sometimes, he has found a difficulty in "telling what a thing is." And this admission is all that the most ardent disciple of Mr. Darwin could desire.

However, the value of the great work which is now being brought before the public does not lie in the speculations which may be based upon it, but in the mass and the solidity of the permanent additions which it makes to our knowledge of natural fact. Sir Wyville Thomson and his colleagues must be congratulated on having made an excellent beginning; the looker-on may properly content himself with wishing them a speedy and a good ending.

T. H. HUXLEY

THE LAVA-FIELDS OF NORTH-WESTERN EUROPE

FROM the earliest times of human tradition the basin of the Mediterranean has been the region from which our ideas of volcanoes and volcanic action have been derived. When the old classical mythology passed away and men began to form a more intelligent conception of a nether region of fire, it was from the burning mountains of that basin that the facts were derived which infant philosophy sought to explain. Pindar sang of the crimson floods of fire that rolled down from the summit of Etna to the sea as the buried Typhoeus struggled under his mountain load. Strabo, with matter-of-fact precision and praiseworthy accuracy, described the eruptions of Sicily and the Aeolian Islands, and pointed out that Vesuvius, though it had never been known as an active volcano, yet bore unequivocal marks of having once been corroded by fires that had eventually died out from want of fuel. In later centuries, as the circle of human knowledge and experience has widened, it has still been by the Mediterranean type that the volcanic phenomena of other countries have been judged. When a geologist thinks or writes of volcanoes and volcanic action, it is the structure and products of such mountains as Etna and Vesuvius that are present to his mind. Nowhere over the whole surface of the globe have eruptions been witnessed different in kind though varying in degree from those of the Mediterranean vents. And hence even among those who have specially devoted themselves to the study of volcanoes there has been a tacit assumption that from the earliest times and in all countries of the world where volcanic outbreaks have occurred, it has been from local vents like those of Etna, the Aeolian Islands, the Phlegraean Fields, or the Greek Archipelago.

If one were to assert that this assumption is probably erroneous, that the type of volcanic "cones and craters" has not been in every geological age and all over the earth's surface the prevalent one, that, on the contrary, it is the less portentous, though possibly always the most frequent type of volcanic action, and belongs perhaps to a feebler or waning degree of volcanic excitement—these statements would be received by most European geologists with incredulity, if not with some more pronounced form of dissent. Yet I am convinced that they are well founded, and that a striking illustration of their truth is supplied by the greatest of all the episodes in the volcanic history of Europe—that of the basalt-plateaux of the north-west.

It is now some twelve years since Richthofen pointed out that on the Pacific slope of North America there is evidence of the emission of vast floods of lava without the formation of cones and craters. Geologists interested in these matters may remember with what destructive energy Scrope reviewed his "Natural System of Volcanic Rocks"; how he likened it to the old crude ideas that had been in vogue in his younger days, and which a study of the classical district of Auvergne had done so much to dispel; and how he ridiculed what he regarded as "fanciful ideas" and "untenable distinctions," which it was "a miserable thing" to find still taught in mining-schools abroad. My own reverence for the teaching of so eminent a master and so warm-hearted a friend led me to acquiesce without question in the dictum of the author of "Considerations on Volcanoes." Having rambled over Auvergne with his admirable sections and descriptions in my hand, I knew his contention as to the removal of cones and craters by denudation and the survival of more or less fragmentary plateaux once connected with true cones to be undoubtedly correct with respect at least to that region. Nevertheless there were features of former volcanic action on which the phenomena of modern volcanoes seemed to me to throw very little light. In particular the vast number of fissures which in Britain had been filled with basalt and now formed the well-known and abundant "dykes" appeared hardly to connect themselves with any known phase of volcanism. The area over which these dykes can be traced is probably not less than 100,000 square miles, for they occur from Yorkshire to Orkney, and from Donegal to the mouth of the Tay. As they pierce formations of every age, including the Chalk, as they traverse even the largest faults and cross from one group of rocks into another without interruption or deflection, as they become more numerous towards the great basaltic plateaux of Antrim and the Inner Hebrides, and as they penetrate the older portions of these plateaux, I inferred that the dykes probably belonged to the great volcanic period which witnessed the outburst of these western basalts. Further research has fully confirmed this inference. There can be no doubt that the outpouring of these great floods of lava of which the hills of Antrim, Mull, Morven, Skye, Faroe, and part of Iceland are merely surviving fragments and the extravasation of these thousands of dykes are connected manifestations of volcanic energy during the Miocene period.

But this association of thin nearly level sheets of basalt piled over each other to a depth of sometimes 3,000 feet, with lava-filled fissures sometimes 200 miles distant from

them, presented difficulties which in the light of modern volcanic action remained insoluble. The wonderfully persistent course and horizontality of the basalts with the absence or paucity of interstratified tuffs, and the want of any satisfactory evidence of the thickening and uprise of the basalts towards what might be supposed to be the vents of eruption were problems which again and again I attempted vainly to solve. Nor so long as the incubus of "cones and craters" lies upon one's mind does the question admit of an answer. A recent journey in Western America has at last lifted the mist from my geological vision. Having travelled for many leagues over some of the lava-fields of the Pacific slope, I have been enabled to realise the conditions of volcanism described by Richthofen and, without acquiescing in all his theoretical conclusions, to judge of the reality of the distinction which he rightly drew between "massive eruptions" and ordinary volcanoes with cones and craters. Never shall I forget an afternoon in the autumn of last year upon the great Snake River lava desert of Idaho. It was the last day of a journey of several hundred miles through the volcanic region of the Yellowstone and Madison. We had been riding for two days over fields of basalt, level as lake bottoms, among the valleys, and on the morning of the last day, after an interview with an armed party of Indians (it was only a few days before the disastrous expedition of Major Thornburgh, and the surrounding tribes were said to be already in a ferment), we emerged from the mountains upon the great sea of black lava which seems to stretch illimitably westwards. With minds keenly excited by the incidents of the journey, we rode for hours by the side of that apparently boundless plain. Here and there a trachytic spur projected from the hills, succeeded now and then by a valley up which the black flood of lava would stretch away into the high grounds. It was as if the great plain had been filled with molten rock which had kept its level and wound in and out along the bays and promontories of the mountain-slopes as a sheet of water would have done. Copious springs and streams which issue from the mountains are soon lost under the arid basalt. The Snake River itself, however, has cut out a deep gorge through the basalt down into the trachytic lavas underneath, but winds through the desert without watering it. The precipitous walls of the cañon show that the plain is covered by a succession of parallel sheets of basalt to a depth of several hundred feet. Here and there, I was told, streams that have crossed from the hills and have flowed underneath the lava-desert issue at the base of the cañon-walls, and swell the Snake River on its way to the Pacific. The resemblance of the horizontal basalt-sheets of this region to those with which I was familiar at home brought again vividly before my mind the old problem of our Miocene dykes and Richthofen's rejected type of "massive" or fissure eruptions. I looked round in vain for any central cone from which this great sea of basalt could have flowed. It assuredly had not come from the adjacent mountains, which consisted of older and very different lavas round the worn flanks of which the basalt had eddied. A few solitary cinder cones rose at wide intervals from the basalt plain, as piles of scoriæ sometimes do from the vapour vents on the surface of a Vesuvian lava-stream, and were as unequivocally of secondary origin. Riding hour after hour among these arid wastes, I became convinced that all volcanic phenomena are not to be explained by the ordinary conception of volcanoes, but that there is another and grander type of volcanic action, where, instead of issuing from separate vents and piling up cones of lava and ashes around them, the molten rock has risen in fissures, sometimes accompanied by the discharge of little or no fragmentary material, and has welled forth so as to flood the lower ground with successive horizontal sheets of basalt. Recent renewed examination of the basalt-plateaux and associated dykes in the west of Scotland has assured me that this view of their origin and connection, which first suggested itself to my mind on the lava-plains of Idaho, furnishes the true key to their history.

The date of these lava-floods of the Snake River is in a geological sense quite recent. They have been poured over the bottoms of the present valleys, sealing up beneath their sheets of solid stone river-beds and lake-floors with their layers of gravel and silt. The surface of the lava is in many places black and bare as if it had cooled only a short while ago. Yet there has been time for the excavation of the Snake River cañon to a depth of 700 feet through the basalt-floor of the plain. In so arid a climate, however, the denudation of this floor must be extremely slow. Much of the plain is a verdureless waste of loose sand and dust which has gathered into shifting dunes. Save in the gorges laid open by the main river and some of its tributaries hardly any sections have yet been cut into the volcanic floor. Dykes and other protrusions of basalt occur on the surrounding hills, but the chief fissures or vents of emission are still no doubt buried beneath the lava that escaped from them.

In North-Western Europe, however, the basalt-sheets were erupted as far back as Miocene times. Since then, exposed to many vicissitudes of geological history—subterranean movement and changes of climate, with the whole epigene army of destructive agencies, air, rain, frost, streams, glaciers, and ice-sheets—the volcanic plateaux, trenched by valleys two or three thousand feet deep and a mile or more in breadth, and stripped bodily off many a square mile of ground over which they once spread, have been so scarped and cleft that their very roots have been laid bare. Viewed in the light of the much younger basalts of the Western Territories of North America, their history becomes at last intelligible and more than ever interesting. We are no longer under the supposed necessity of finding volcanic cones vast enough to have poured forth such wide-spread floods of basalt. The sources of the molten rock are to be sought in those innumerable dykes which run across Britain from sea to sea, and which in this view of their relations at once fall into their place in the volcanic history of the time.

No more stupendous series of volcanic phenomena has yet been discovered in any part of the globe. We are first presented with the fact that the crust of the earth over an area which in the British Islands alone amounted to probably not less than 100,000 square miles, but which was only part of the far more extensive region that included the Faroe Islands and Iceland, was rent by innumerable fissures in a prevalent east and west or south-east and north-west direction. These fissures, whether due

to sudden shocks or slow disruption, were produced with such irresistible force as to preserve their linear character and parallelism through rocks of the most diverse nature, and even across old dislocations having a throw of many thousand feet. Yet so steadily and equably did the fissuring proceed over this enormous area, that comparatively seldom was there any vertical displacement of the sides. We rarely meet with a fissure which has been made a true fault with an upthrow and downthrow side.

The next feature is the rise of molten basalt up these thousands of fissures. The most voluminous streams of lava that have issued from any modern volcanic cone appear but as a minor manifestation of volcanic activity when compared with the filling of those countless rents over so wide a region. Mining operations in the Scottish coal-fields have shown that dykes do not always reach the surface. In all parts of the country, too, examples may be observed of breaks in the continuity of dykes. The same dyke vanishes for an interval and reappears on the same line, but is doubtless continuous underneath. What proportion of the dykes ever communicated with the surface at the time of their extravasation is a question that may perhaps never be answered. It is difficult to believe that a considerable number of them did not overflow above ground even far to the east of the main and existing outflows. But so extensive has been the subsequent denudation that all trace of such superficial emission has been removed. The general surface of the country has been lowered by sub-aërial waste several hundred feet at least, and the dykes now protrude as hard ribs of rock across the hills.

Traced westwards the dykes increase in abundance, till at last they reach the great basaltic plateaux. Macculloch long ago sketched them in Skye, rising through the Jurassic rocks and merging into the overlying sheets of basalt. Similar sections occur in the other islands and in the north of Ireland. The lofty mural escarpments presented by the basalt plateaux once extended far beyond the limits to which they have now been reduced. The platform from which they have been removed shows in its abundant dykes the fissures up which the successive discharges of lava rose to the surface, where they overflowed in wide level sheets like those still so fresh and little eroded in Western North America.

That there were intervals between successive outpourings of basalt is indicated by the occasional interstratification of seams of coal and shale between the different flows. These partings contain a fragmentary record of the vegetation which grew on the neighbouring hills and which may even have sometimes found a foothold on the crumbling surface of the basalt floor until overwhelmed by fresh floods of lava. Not a trace of marine organisms has anywhere been found among these interstratifications. There is every reason to believe that the volcanic eruptions were all subaërial. Sheet after sheet was poured forth over the wide valley between the mountains of Donegal and the Outer Hebrides on the one side and those of the north-east of Ireland and the west of Scotland on the other, until the original surface had been buried in some places 3000 feet beneath volcanic ejections.

I believe that the most stupendous outpourings of lava in geological history have been effected not by the familiar type of conical volcano, but by these less known fissure-eruptions. Both types are of course only manifestations in different degrees of the same volcanic energy. It is by no means certain that the "massive" or fissure type belongs wholly to former geological periods. In particular one is disposed to inquire whether the great Icelandic lava-floods of 1783—the most voluminous on record—may not have been connected rather with the opening of wide-reaching fissures than with the emissions of a single volcanic cone. The reality and importance of the grander phase of volcanism marked by fissure-eruptions have been recognised by some of the able geologists who in recent years have explored the Western States and Territories of the American Union. But they have not yet received due acknowledgment on this side of the Atlantic, where the lesser type of cones and craters has been regarded as that by which all volcanic manifestations must be judged. We are fortunate in possessing in the north-west of Europe so magnificent an example of fissure-eruptions, and one which has been so dissected by denudation that its whole structure can be interpreted. The grand examples on the Pacific slope of America have yet to be worked out in detail, and will no doubt cast much fresh light on the subject, more especially upon those phenomena of which in Europe the traces have been removed by denudation. But the other continents also are not without their illustrations. The basaltic plateaux of Abyssinia and the "Deccan traps" of India probably mark the sites of some of the great fissure-eruptions which have produced the lava-fields of the Old World. In their recent admirable *resumé* of the "Geology of India," Messrs. Medlicott and Blanford describe the persistent horizontality of the vast basalt-sheets of the Deccan, the absence of any associated volcanic cones or the least trace of them in that region, and the abundance of dykes in the underlying platform of older rocks where it emerges from beneath the volcanic plateaux. They confess the difficulty of explaining the origin of such enormous outpourings of basalt by reference to any modern volcanic phenomena. Their descriptions of these Indian Cretaceous lava-floods might, however, be almost literally applied to the Miocene plateaux of North-western Europe and to the Pliocene or recent examples of Western North America.

ARCH. GEIKIE

THE ATOMIC THEORY

The Atomic Theory. By Ad. Wurtz, Membre de l'Institut, &c. Translated by E. Cleminshaw, M.A. (London: C. Kegan Paul and Co., 1880.)

THE latest addition to the International Scientific Series is at once a scientific treatise and an artistic work. The translator has very fairly maintained the clearness and crispness of the French style, whereby the book is marked with a distinct individuality and self-completeness.

The sharpness of the impression which this work produces on the mind is gained without making any great sacrifice of accuracy, although it must be confessed there is, in some chapters, a lack of detailed facts, which is against the value of the work as a reference book for the advanced student; and in others there is too free a use of fancy, which faculty is not synonymous with that

other without which no great scientific work can be produced, viz., imagination.

The work is divided into two books: the first, and most valuable, treating of "Atoms," the second of "Atomicity." The historical introduction is very full, and remarkable for the clear exposition of the work of Richter, which was of so much importance in the subsequent development of the doctrine of atoms. The error, which is still fallen into in some books, of attributing the "law of proportionality" to Wenzel is pointed out and corrected.

Full justice is not done to the work of Avogadro, on which, confirmed as it has been by physical evidence, rests the structure of modern chemistry. The distinction between "integral molecules" and "elementary molecules" was clearly stated by Avogadro in 1811, three years before the date of the publication of Ampère's letter to the Comte Berthollet. Ampère's attempt to extend the hypothesis to facts concerning crystalline bodies cannot be regarded as an improvement on the simpler conception of Avogadro.

But throughout this work there is a manifest resolve to abate no jot nor tittle of that assertion, which, made with the plenary knowledge of a chemical Philistine, sounded the keynote of M. Wurtz's well-known "History of the Atomic Theory."

The statement on p. 42 of the reasons for adopting H_2 as the standard of molecular weights is neither clear nor satisfactory. The student might readily suppose that this standard is adopted simply for the sake of convenience; he might also be led to regard the statement of Avogadro's law, on this page, as a deduction from some vaguely-expressed relations between the number of atoms in elementary molecules and the volumes occupied by these atoms.

Few text-books make clear the fundamental deficiency of the Daltonian theory, viz., the absence of any trustworthy means for determining the weights of the "atoms" (or as we now say, molecules) of compound bodies. Dalton, and Berzelius after him, laid down rules for determining these weights, but the rules of both chemists were wholly empirical. "The atomic weight of an element is the smallest amount of that element which combines with unit-weight of hydrogen to form an atom of a compound," but so long as the "atom" of the compound was undefined, the atomic weight of the element could not be determined.

Avogadro furnished chemists with a means of determining the molecular weights of all gasifiable bodies; and in modern chemistry determinations of molecular weights of many compounds of a given element, and analyses of these compounds, must precede the determination of the atomic weight of the element itself.

The atomic weight of an element is the smallest amount of that element—referred to hydrogen as unity—contained in the molecule, that is in two gaseous volumes of any compound thereof. For lack of a clear differentiation between atom and molecule, and for lack of a definite statement of how atomic weights are determined, the full and valuable table, extending from p. 104 to 109, loses much of its meaning. This table, by the way, very closely resembles a table which occurs in Lothar Meyer's "Die modernen Theorieen"; the alterations made by M. Wurtz certainly do not add to the value of the table.

Dalton's objections to the generalisation of Gay Lussac, that "equal volumes of gases contain equal numbers of atoms," was, as we now know, perfectly justifiable, but on p. 35 Dalton is said to have repudiated "the solid support which the great French chemist gave to his ideas."

Gay Lussac's generalisations could not be true, said Dalton, because of such a reaction as that between nitrogen and oxygen, wherein equal volumes of each combine, and the product, nitric oxide, measures twice the volume of either; that is, there are, according to Gay Lussac, twice as many atoms of nitric oxide as of oxygen or nitrogen; but as elementary atoms are chemically indivisible, this is impossible. Berzelius obviated, or rather shirked, the difficulty by applying Gay Lussac's generalisations to elementary gases only, but a full reconciliation between the views of Dalton and those of Gay Lussac was only possible when Avogadro's fruitful idea of the existence of molecules as distinct from atoms was fully recognised in chemical science.

In describing the physical methods for checking atomic weight determinations, the law of Dulong and Petit is stated in too absolute a manner; if the data concerning the specific heats of the elements are carefully considered, it is evident that in many cases the value varies very much with temperature, that in others no direct determination of specific heat has yet been made, and that the law cannot be regarded as a final statement of the connection between the specific heats and atomic weights of the elements.

The state of our knowledge with regard to the structure of molecules, indeed, renders a full understanding of specific heat at present impossible. The dynamical theory of gases has not yet been fully worked out in this direction.

Although the "law of Avogadro" is a deduction from the dynamical theory of gases, and as such is invested with an authority which no mere collection of empirical facts can bestow upon it, yet nowhere in M. Wurtz's book is this insisted upon.

The compromise between an atomic and an equivalent system of notation, which was so long adopted by chemists, is well described and its evils fully laid bare.

The objectors to Avogadro's law are more numerous and more important in France than in this country or in Germany, hence M. Wurtz devotes considerable space to the subject of dissociation, which he discusses with much clearness and wealth of illustration.

The demonstration on pp. 121-123 of the monatomic character of the mercury molecule is admirable.

In the list of names of those who have pointed out relations between the atomic weights of elements and properties of their compounds, there is a serious omission, viz., the name of A. R. Newlands. This subject of relation between atomic weights and properties of compounds is discussed on pp. 154-176. A better idea of Mendelejeff's "periodic law" may be obtained from these pages than probably from any other English text-book, but surely it would have been well had the author more explicitly acknowledged his indebtedness to Lothar Meyer's work. The graphic representation of the relations between the atomic weights and physical properties of the elements—taken from Meyer's book—has not hitherto been in the hands of the English student.

The second part of M. Wurtz's book, dealing with Valency, is not, in our opinion, of equal value with the first.

After reading these chapters one finds it hard to find a reason for introducing into science the conception of valency, so variable and shifting is this property of atoms made to appear.

On p. 229 it is stated that chlorine is monovalent in $HClO$, pentavalent in $HClO_3$, and heptavalent in $HClO_4$.

Scarcely a hint is given of the many objections to extending considerations concerning valency, in any but a most tentative manner, to non-gasifiable bodies. The theory of molecular as distinct from atomic compounds is dismissed; all are regarded as atomic, and the valencies of the atoms seem variable at pleasure. Where proof of the valency of atoms is not forthcoming, assertion is used in its place.

The author's treatment of affinity is not satisfactory. "Affinity is the force of combination, chemical energy." "Atoms attract each other, and this atomic attraction is affinity." "Thus we know that while hydrogen is united to chlorine with extreme energy, oxygen combines with less force." Surely the translator is to blame for some of these sentences.

The theory of valency deserved a more rigorous and exact treatment than M. Wurtz has given it.

We leave the book, feeling that it is the production of a brilliant author, not the work of a deep thinker.

M. M. P. M.

NEW ZEALAND MOLLUSCS

Manual of the New Zealand Mollusca. By Frederick Wollaston Hutton, F.G.S. Published by command. (Wellington, 1880.)

IN an interesting article which appeared in NATURE, vol. xxii. p. 461, entitled "The New Zealand Institute," attention was called to the publications of the Institute and to the excellent work in science achieved by the author of the manual above mentioned, and by many other naturalists, as well by geologists, chemists, astronomers, archæologists, physicists, and philosophers. When the traditional New Zealander visits the ruins of the old country, it is to be feared that he will lament our ignorance instead of expressing his admiration of our past eminence.

Prof. Hutton seems to have contributed to the publications of the Institute a number of valuable papers on "the various divisions of the fauna of New Zealand." We are not quite sure that our knowledge of any one department of the fauna would be so much advanced by a multifarious zoologist as by a specialist who has devoted himself to the study of that department. The division of labour is not less desirable in natural history than in other equally extensive fields of work. The material is so vast that a Linné, Buffon, or Cuvier would be now rather an anachronism than a marvel.

The present work is called "A Systematic and Descriptive Catalogue of the Marine and Land Shells, and of the soft Mollusks and Polyzoa of New Zealand and the adjacent Islands." It belongs to the Colonial Museum and Geological Survey Department, of which Dr. Hector, the well-known geologist, is the director. Its scope is most useful; and, as the preface by Dr. Hector very properly states, "an accurate knowledge of the affinities and distribution of the recent shells of New Zealand is a very necessary element in the geological survey of the country, as it must form the basis of our Tertiary geology, upon the correct deciphering of which many questions of the highest interest depend." And he adds, "Shells afford the most reliable data for palæontologists; but before the extinct shell-fauna can be utilised, the recent shells of the area must be thoroughly determined." This is quite true. We are disposed, however, to carry the process a step further. It is not enough to determine or make out the recent shells, but they must be critically compared with their fossil analogues. For want of such comparison the late Prof. Nyst, M. Vandenbroeck, and other Belgian palæontologists have unfortunately caused some confusion by a wrong identification of recent or living species with Tertiary species.

The "Manual" contains 237 pages. There are no plates or illustrations. It appears to comprise all that is known of the subject, and to have been conscientiously and on the whole carefully written. But, like all other books, it is not faultless. In the Bibliography "Linneus" is the name given as the author of the 12th edition of the "Systema Naturæ." It ought to be "Linné," according to the title-page and dedication. "Gastropoda" is now the usual, as well as correct, spelling of the class, not "Gasteropoda." The shell of the family *Patellidæ* is not a simple cone, but is spiral in the young. The *Bullidæ* are not all eyeless. The sub-order "Lucinacea" is described as having the gills, "one on each side"; but in one of the families of this sub-order there are "two gills on each side." The family "*Radulidæ*" is stated to have the foot "not byssiferous"; *Limahians* with its foot spins a byssus and makes its curious nest. In the "Artificial Key to the Marine Shells" the remarkable class *Solenoconchia* (or as Prof. Hutton in another place prefers to call it, "Scaphopoda") is omitted. The shell in "*Capulidæ*" is described as "not spiral." These and other less important errors can be corrected in a future edition. We regret, but are not surprised, to see the remark that "not much dependence can be placed on the localities in Mr. Cuming's collection," which was purchased for the British Museum at a large price. This is the case with all dealers, and it sadly disturbs our ideas of geographical distribution. We are inclined to question even such species as *Ostrea edulis*, *Mytilus edulis* and *Lucina* (*Loripes*) *divaricata* as indigenous to New Zealand. These are included in a list of sixty-four species believed by the author to be the only New Zealand species of which there is evidence that they are found anywhere else, although he admits that the identification has in most cases been made solely by descriptions and figures. The same remark applies to *Cypræa europæa*, "*Philippia lutea*" = *Solarium hybridum*, *Littorina cærulescens* = *ueritoïdes*, and *Crepidula unguiformis*. But, *per contra*, the *Saxicava australis* of Lamarck is scarcely a variety of *S. rugosa*, Linné. The diagnosis of the soft parts, or "animal," of *Vitrina* and *Succinca*, viz., "too large to enter the shell," does not suit the European species of those genera. In the family *Assiminiidæ* the eyes are placed not "on the middle of the tentacles," but on their tips. "*Odostomia lactea*" is not the Linnean species of

Turbo, but another species so named by Mr. Angas. Nor is the *Nucula sulcata* of A. Adams the same as Bronn's much older species of that name. But a serious defect of the work consists in the description of the shells. We give one instance among many. *Littorina novæ zealandiæ* is described as "somewhat globosely turbinated," with the whorls "spirally irregularly linearly grooved;" and the characters of the several species are not arranged systematically or in any kind of sequence. Dog-Latin would be almost preferable to such English. Perhaps, however, the description of species made by the late Mr. Reeve may have been copied from his "Conchologia Iconica." Prof. Hutton says that there are "between 300 and 400 species" of the New Zealand mollusca and polyzoa. This is considerably less than half the number of those species which have been recorded as inhabiting the British seas. J. GWYN JEFFREYS

OUR BOOK SHELF

The Zoological Record for 1878*;* being vol. xv. of the Record of Zoological Literature, edited by E. C. Rye. (London: John Van Voorst, 1880.)

THIS publication seems to pursue the even tenor of its very useful way. The editor has to acknowledge grants of 250*l.* towards the expenses of the work from the British Association for the Advancement of Science, the Royal Society, and the Zoological Society of London. The "Record of the Arachnida for 1878" has been unavoidably postponed until vol. xvi., and Mr. Kirby has for the future undertaken all of the groups of the Insecta with the exception of the Coleoptera, which the editor will still review. Entomologists will perceive with regret that they thus lose the services of Mr. McLachlan, who has reported on the Neuroptera and Orthoptera since 1869. A special committee has been appointed to endeavour to expedite the publication of the annual volume, and arrangements have been made, both as regards the contributors and printers, which it is hoped will have the eventual effect of bringing out the record of one year's work during the succeeding year. This would be an immense boon, and though it is obvious that it cannot be effected at the first attempt, still the editor confidently expects that the Record of 1879 will be published in the beginning of 1881, and let us hope that ere the end of that year we may also have the Record of that one now coming to a close.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Recent Gas Explosion

ON my return after the vacation the experiments on the explosion of gases in tubes were continued.

A tube was constructed by winding narrow strips of paper helically round a glass tube about 8 mm. in diameter; two-thirds of the width of the paper being glued, it was so wound as to make a tube of three thicknesses of paper. The interior of the tube was afterwards varnished with shellac. At the ends short pieces of glass tube about 5 mm. in diameter were fixed, one being provided with platinum wires in order to inflame the gas; the total length of the tube was 4360 mm.

The tube was filled with a mixture of oxygen and hydrogen, the end of the glass tube with the wires was plugged with wet cotton wool, the other tube being closed with an india rubber cap; a spark was then passed. At a distance of 650 mm. from the open end, at which the ignition took place, the outer covering of the tube was split; at a distance of 1,900 mm. from the same point was a hole, at 3030–3040 another hole, and at 3085–3100 a third hole. The india-rubber cap was blown off the end of the tube. At the third hole the interior coating of the tube was torn and blown back towards the opening, showing that the orifice had allowed the escape of gas from both directions. Measuring the distances between the holes and the ends of the tube, we have the following numbers:—From end to first split, 650 mm.; from split to first hole, 1250; from first hole to mean of second and third, 1200; from this point to end of tube, 1260.

There seemed to be some doubt as to the uniformity of this tube, so another was made by rolling a strip of paper helically along a glass tube in such a manner that the edges did not overlap. A glued strip was wound over this so as to cover the joint; and a third to cover the joint of the second, the edges not overlapping and yet touching one another throughout. The process was very tedious, and as the result showed, not successful. This tube was 7·5 mm. in diameter, and the glass ends 4·5, the total length being 8390 mm. The end of the tube farthest from the wires was firmly closed, after introducing the explosive mixture. When the gas was exploded in the tube 14 holes were made, in some places the tube giving way at joints, but without any great tear of the paper. Starting from the end of the tube the first hole was at 620 mm., the other holes being distant from one another 650, 530, 100, 475, 375, 320, 580, 455, 370, 885, 2115, 365, 85, and the other end 465 from the last hole.

A third tube was now constructed, but on a different principle. A sheet of glued paper was wound round a brass tube and at once removed; in this way a tube about 275 mm. long and 13·5 wide, and consisting of about 5 layers of paper was obtained. Thirty-two of these were joined end to end by glueing narrow strips of paper round the joints. The tube was varnished inside and out, and when completed was 9000 mm. long. The experiment was made after dark, and it was not found out until afterwards that a small quantity of water had entered the tube from the gas-holder while introducing the gas. In this case the explosion made 10 holes, but the joints obviously considerably strengthened the tube in their neighbourhood. The distances between the holes were not more regular than in the previous case. From the end to first hole 757 mm.; the other holes being distant 660, 1595, 146, 484, 230, 295, 308, 1325, 585, to end 2615. The end was not opened by the explosion.

Although these experiments have not exhibited the regularity I anticipated, they show that a tube burst by an explosive mixture must not be expected to open along its whole length.

Cooper's Hill, October 25 HERBERT MCLEOD

Geological Climates

I WAS not surprised at reading Mr. Duncan's letter in supposed reply to my communication to NATURE, vol. xxii. p. 532, as it fully proves my case against the slipshod logic of geologists in general. He writes:—"Where I now write, on the Bagshot sands and gravels of Cooper's Hill, facing the cold north with a touch of the east, there is a patch of bamboo canes in full leaf. They were in full leaf at this time last year. The plant survived out of doors the extreme frost and fogs of last winter and other evidences of a temperate climate, and it has been in beautiful leaf all this summer.

"Now everybody knows that in torrid India the bamboo grows . . ."

Mr. Duncan might as well have told your readers that where he now writes, "facing the warm south with a touch of the west," he beheld before his astonished eyes a tuft of grasses.

He has not named the *species* of the "patch of bamboo canes" which delighted his eyes, and which "everybody" knows came from "torrid India."

If Mr. Duncan does not know, at least "everybody" does, that species of the bamboo canes flourish in every latitude from Northern China to Southern Chili, including "torrid India," where in some places you may have a half-inch thick of ice, in consequence of the starlight radiation of a clear summer's night.

I have before me a list of twenty-four species of bamboo canes cultivated in most of the gardens of Europe, but they are all, with the exception of a species from the Himalayas (not "torrid India"), imported from the severe climates of Northern Japan and China.

At Fota, in the Cove of Cork, at Bamboo Island, they have lived, fruited, and reproduced themselves for nearly thirty years, and will probably continue to do so in the future, although no Corcagian will be silly enough to believe in consequence thereof that he is living in the climate of "torrid India."

In fact, I adduced the evidence of *Araucaria Cunninghami*, a *most delicate self-registering plant thermometer*, in testimony of the Eocene climate of Bournemouth; and I find myself confronted with Mr. Duncan's clumsy thermometer with *not a single fixed point on its scale*, in the shape of an unspecified "*clump of bamboo canes*." Let Mr. Duncan name the species included in his "clump," and I shall discuss the question fully with him.

The facts stated in my letter, although by no means uncommon, prove most convincingly to those who can appreciate them the untenable nature of Lyell's theory of the cause of change of geological climates.

I must state my argument again :—

1. In Eocene times groves of Moreton Bay pine lived, flourished, and held their ground at Bournemouth against all comers.

2. At the present time groves or forests of Moreton Bay pine live, flourish, and hold their ground at Moreton Bay against all comers.

3. Therefore the climate of Bournemouth in Eocene times was similar to that of Moreton Bay at the present time.

Geologists often make use of syllogisms much less conclusive than the above, which is as good as any commonly used in biological reasoning, such as it is.

The present mean temperature of Bournemouth is 20° F. below what it was in Eocene times, which is equivalent to a difference of latitude in the northern hemisphere between 31° N. and 51° N.

Sir Charles Lyell[1] feebly attempts to get rid of scientific conclusions as to temperature in two ways :—

1. By a denial of the specific identity of the former and recent species compared.

2. By the unproved hypothesis of competing plants whose superior vigour and not climatal conditions, account for the absence of the species which formerly flourished.

In the case of the Moreton Bay pine I shall leave Mr. Gardner to defend the asserted identity of species; and I meet Sir Charles Lyell's second supposition (which is really romance writing, and not science) by the assertion that the Moreton Bay pine, even if protected by man, will perish in any locality whose *mean winter temperature* falls below 57° F.

The present mean January temperature of Bournemouth is 37°·4 F., a temperature which would destroy in a single night a whole forest of Moreton Bay pines.

I was of course well aware that my argument from the former existence of Moreton Bay pines at Bournemouth was only one of many similar arguments that might be advanced from the former existence of plants or corals in localities in which they do not now live.

I know nothing, except from books, of the water temperature necessary for the several species of corals, nor do I know whether any species of the tertiary corals found in England are *specifically identical* with corals now living elsewhere. If Mr. Duncan would give us precise information on this subject he would throw most valuable light on geological climates.

The corals would give us more information upon the question than plants, because they would gauge for us the temperature of the water in England; that is to say, the temperature of the former Gulf streams of the tertiary period, from which we could calculate numerically the increase of solar radiation, necessary to produce such former Gulf streams; and possibly afterwards a measure of geological time.

I have elsewhere[2] shown that the fossil tertiary plant beds of the Arctic regions show a falling off of temperature similar to that which has been proved at Bournemouth, of which the following is a summary :—

	Lat.	Mean annual temperature in Miocene time.	Reduction at present.
Grinnell Land	81°·44	42°·3 F.	44°·00 F.
Spitzbergen	78·00	51·8 ,,	35·30 ,,
Disco	70·00	55·6 ,,	36·00 ,,
		Eocene.	
Bournemouth	50·50	70·75 ,,	20·35 ,,

I again assert that it is not possible to explain these facts without introducing causes differing in amount from those now acting on our planet. SAML. HAUGHTON

Trinity College, Dublin, October 16

[1] "Principles," vol. i. p. 173 (twelfth edition).
[2] "Lectures of Physical Geography," p. 344.

The Yang-tse, the Yellow River, and the Pei-ho

I READ with great interest the paper on the Yang-tse, &c., in NATURE, vol. xxii. p. 486. It seems to me that Mr. Guppy has underestimated the quantity of water and sediment in these rivers. As to the Yang-tse, this arises from the year 1877 being one of the driest in Western and Central China generally, and thus the summer flood must have been one of the lowest on record. Besides what we know of the character of the season, an indirect proof of this can be had by comparing the rate of discharge in April and at the time of highest flood, as given by Mr. Guppy, with what is said by Mr. Oxenham, in his paper on the inundations of the Yang-tse.[1] According to the latter the rise of water in April is not very large, the river not yet inundating its banks, and being thirty feet below the summer level. Thus in an average year the discharge in April would by far not equal half of that of August, as found by Mr. Guppy, but more probably be even below one-fifth of that of flood-time.

On this account the data given by Mr. Guppy for the Yang-tse are far below the average as to the discharge of water, and probably even more so as to the amount of sediment, as the proportion of sediment increases during high floods. In 1877 the loess country of North-West China was subject to the severest drought, so that the Han river, which generally contributes so much to the sediment of the main river, must have been very low in summer.

As to the estimation of the discharge of water in the Pei-ho, it is certainly much below the actual quantity, for Mr. Guppy has taken only the months of December to March, *i.e.* months of low water. The monsoon character of the rains, *i.e.* the great prevalence of summer over winter rains, is far more marked in Northern China than in the middle part of that country, so that the flood discharge of the rivers during and after the rains (*i.e.*, from July to October) must be enormously in excess over that of winter. If, as Mr. Guppy says, the Pei-ho rises only six feet at Tien-tsin, this must be due to the banks being very low, so that the river during flood-time inundates the plain to a very great extent.

My conclusion is this :—Mr. Guppy having underestimated the discharge of water of the Yang-tse and Pei-ho in the mean of the year, this must have been even more the case as to the amount of sediment carried. Thus the relatively short time at which he estimates that the surrounding seas will be filled by the sediment carried by the great Chinese rivers has to be greatly shortened, and if he thinks 36,000 years enough for the work, I should estimate that 28,000 years would be sufficient.

A. WOEIKOF

Schpalernajo 8, St. Petersburg, October 15

Greek Fret

IN NATURE, vol. xxii. pp. 513-14, there is a very interesting account of the development of ornament as illustrated by General Pitt Rivers' Anthropological Collection. I would venture to suggest that though in the majority of cases the Greek fret pattern

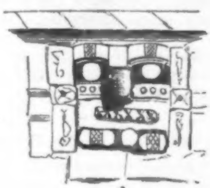

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FIG. 1.—Gateway at Labnah (Plate 19).

was independently evolved in different countries from the "double loop-coil," yet a study of the plates in Mr. Catherwood's beautiful work, "Views of Ancient Monuments in Central America" (1844), suggests to me the probability that the builders of those remarkable structures arrived at the "Greek pattern" through a degradation of the conventionalised human

[1] *Journ.* R. Geog. Soc., 1875.

face. The accompanying tracings from Catherwood's work will sufficiently explain my meaning.

Fig. 1, from the gateway at Labnah, pl. xix.; Fig. 2, from the gateway of the great Teocallis Uxmal, pl. xii.; Fig. 3, from

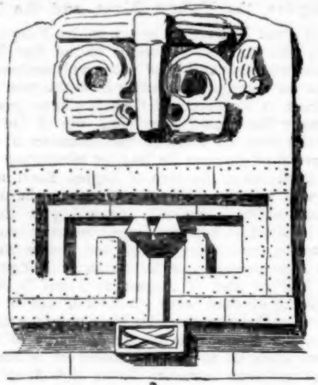

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FIG. 2.—Gateway of the Great Teocallis Uxmal (Plate 12).

Las Monjas Chichen Itza, pl. xxi., illustrate the development of the fret. Fig. 4, from Las Monjas Chichen Itza, pl. xxi., shows another modification of the human face.

In his "Grammar of Ornament" Owen Jones says (p. 35): "In Mr. Catherwood's illustrations of the architecture of Yucatan

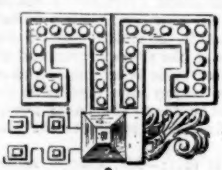

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FIG. 3.—Las Monjas Chichen Itza (Plate 21).

we have several varieties of the Greek fret: one especially is thoroughly Greek. But they are, in general, fragmentary like the Chinese." The reason I would assign for this "fragmentary" natrre of the design is that it was just passing from the disjointed *ornament* to the *pattern* stage. An examination of the plates

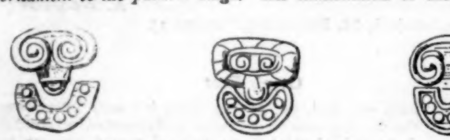


FIG. 4.—Las Monjas Chichen Itza (Plate 21).

will prove the profuse employment of the more or less grotesquely modified human face in mural decoration.

The hypertrophy of one set of organs, with the atrophy of another, and modification of a third, are paralleled in the specialisations of all degraded forms. ALFRED C. HADDON

Zoological Museum, Cambridge

Temperature of the Breath

I AM unable to see what bearing "I. J. M. P.'s" suggestion that I should try the effect of dipping my thermometer, enveloped in a tightly-rolled handkerchief, in water at 108° has on this subject. Every one of course knows that a thermometer in such circumstances would eventually acquire the temperature of the water in which it is immersed.

The state of the matter is simply this: On the one hand works on physiology agree in stating that the normal temperature of the breath is from 95° to 97°, and that of the interior of the body from 98°·5 to 99°·5. These are what Mr. McNally would call "ascertained physiological truths." On the other hand I find that by breathing on the bulb of a thermometer enveloped in about twenty folds—more or less—of a silk, cotton, or woollen cloth for five minutes, the thermometer indicates temperatures varying—owing to conditions not yet precisely ascertained—from 102° to 108°, which, as every one knows, are temperatures vastly greater than the accepted temperature of the breath or interior of the body.

There is no question of squeezing up the reading of a delicate thermometer by the tightness of the enveloping material, for the thermometer used in these experiments is an ordinary clinical thermometer, such as I use daily in practice, the bulb of which is made of such stout glass that no amount of pressure short of breaking the bulb will move the mercury in the slightest degree.

The following variation in the mode of experimenting precludes the possibility of any pressure on the thermometer. I put the thermometer in a glass tube about three-fourths of an inch bore, open at both ends, packed the stem loosely with cotton wool, but left the bulb free at one end of the tube. I then enveloped the whole in a silk handkerchief and breathed through twelve folds of the material into the end of the tube where the bulb of the thermometer was, untouched by cotton wool, glass tube, or silk handkerchief. After five minutes the thermometer showed a temperature of 102°. In this case, and I believe also in my former experiments, the enveloping material merely acted as a bad conductor, retaining the heat produced by the breath.

As any one can easily repeat these experiments for himself, I would suggest to your correspondents that they should do so. When the facts have been established by reiterated experiments—my own observations have been corroborated by several of my friends—the explanation or significance of them will no doubt be speedily arrived at. Provisionally I suggest that these observations show respiration to be a powerful agent for getting rid of the superfluous caloric of the body.

How is this heat communicated to the breath? If it had anything to do with the conversion of the carbon of the blood into carbonic acid, the quantity of carbonic acid passed off by the breath would be greater when the temperature of the latter is higher, less when it is lower. But Letellier's experiments show that the amount of carbonic acid exhaled is greatly *increased by external cold*, and *diminished by heat*; whereas my experiments apparently show that the temperature of the breath is *lower in external cold, higher in heat*.

To solve the questions suggested by these experiments one would require the aid of a physiological laboratory, but as that is not at my command, and, moreover, as I could not devote the necessary time to them, I must leave their solution to others.

October 20 R. E. DUDGEON

Soaring of Birds

I BEG to send you some data on the above subject, as I live where the phenomenon is of daily occurrence. Most of the large birds out here soar, *i.e.* can circle round and round without flapping the wings, and also can *rise* thus from 100 or 200 feet to some 8,000 by same means. The pelican, the adjutant, and several large birds allied to it, the vulture and the cyrus, rise thus.

Firstly they rise by flapping the wings vigorously, and when up some 100 or 200 feet, *if there is a breeze*, begin to soar in large circular sweeps, rising 10 to 20 feet at each lap, the whole bird being otherwise quite motionless, and the wings extended rigidly.

We have two steady winds here, from north east and west-south-west, and in one of these the birds rise to great heights, and can be seen as small specks up in the blue, and watched with telescope, going round and round, motionless otherwise. The following data are trustworthy:—The birds weigh from 20 to 40 lbs.; spread of wings, 10 to 12 feet; stand 3 to 5 feet high; speed flying or soaring, about 15 to 35 miles per hour (estimated).

They rise by flapping the wings. If there is no wind they $\left\{\begin{matrix}\text{do not}\\ \text{cannot}\end{matrix}\right\}$ soar; they generally begin to soar at 100 to 200 feet elevation when above the level of the forest. In soaring they $\left\{\begin{matrix}\text{do not}\\ \text{cannot}\end{matrix}\right\}$ go in a right line, but in large curves of a spiral that leans to *leeward*.

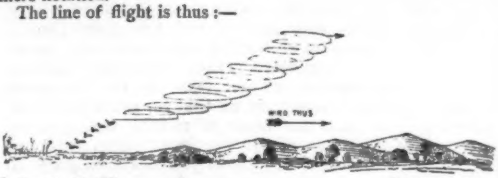
At each lap they can rise 10 to 20 feet, but lose position laterally of 20 to 50 feet to leeward. The soaring can go on without once flapping the wings, till the bird is almost out of sight.

If near, the feather-tips make a loud musical "sing," and the presence often first known by it. If watched, they come

round again nearly to the same place. With gun or rifle against a tree-stem, I have often been able to spot the intersection with my aim beforehand, lap by lap; the drift is to leeward.

I take it the explanation is, that in passing round *with* the wind, and by slightly falling, great impetus is gained, which is slowed down by turning to meet and rise on the wind *like a kite* (if near, this is *seen*). I have seen the albatross and gulls floating, but this case or these cases exemplify a major problem of rising as well steadily and without effort; it is also a clearer problem, the solution of which more or less solves the minor problems of mere flotation.

The line of flight is thus:—



Sapakati, Sibsagor, Asam S. E. PEAL

Regelation

IT is stated in NATURE, vol. xxii. p. 589, that Faraday gave the name of *Regelation* to the phenomenon of two pieces of ice freezing together. Surely this is an error? It was in 1856 when Sir Joseph D. (then Dr.) Hooker, Professors Tyndall and Huxley, and the present writer were in Switzerland together. Prof. Tyndall asked us to suggest a suitable term for the process; and it was Sir Joseph Hooker who said he could think of none better than *Regelation*. Prof. Tyndall instantly accepted it as exactly conveying the meaning he required.

Agassiz, however, in writing upon the difficulties of ascertaining the temperatures of glaciers by introducing thermometers into borings, alludes amongst others to "la difficulté d'extraire les fragmens détachés qui se *regelaient* constamment" ("Études sur les Glaciers," p. 203). This shows that a similar expression had occurred to him as suitable for this phenomenon, as early as 1840, in which year his "Études" were published.

GEORGE HENSLOW

JOHANNES RUDOLF VON WAGNER

WE have already briefly alluded to the loss suffered by chemistry in the sudden death from heart-disease of Prof. von Wagner, which occurred at Würzburg, October 4. Johannes Rudolf Wagner was born February 13, 1822, at Leipzig. As a student in the university of his native city he made choice of chemistry as a profession, and supplemented the then somewhat limited advantages of the Leipzig laboratory by a course of study at Paris, whither students from numerous countries were attracted by the brilliant lectures and investigations of Dumas. His residence there was followed by a lengthy journey to the various centres of scientific interest in France, Belgium, Holland, and Germany, after which he returned in 1846 to Leipzig to accept a position as assistant in the chemical laboratory of the university. In 1851 he was appointed Extraordinary Professor of Technical Chemistry at the Nürnberg Polytechnic. In 1856 he accepted a call to the Chair of Technology at the University of Würzburg, a position which he occupied until the time of his death. During this same time he also filled two important offices, that of Director of the Technological Conservatory at Würzburg, and (until 1868) that of Royal Examiner of the establishments for Technical Instruction in Bavaria. His peculiar abilities and wide range of experience led to his being frequently sent abroad by the Bavarian Government on scientific missions, notably in 1858 to England and Holland, and in 1861 to Paris. The same reasons led to his being called upon to play an important *rôle* in the International Exhibitions of the past twenty years. He was successively appointed on the juries for chemical products at the Exhibitions of London (1862), Paris (1867), and Amsterdam (1869). At Vienna (1873) he was the Chief Commissioner of Bavaria, and at Philadelphia (1876) he was a leading member of the German Commission. The marked services which he rendered in connection with the Vienna Exhibition were recognised by his sovereign, who raised him to the nobility, and decorated him with the Order of the Crown. Prof. von Wagner was the recipient likewise of numerous decorations from most of the European countries.

The career of Wagner has been one of unusual and varied activity. Apart from the multifarious duties of an executive character which we have briefly enumerated, he found time to render to pure chemistry, and especially to applied chemistry, services of incalculable value. Like Poggendorff in physics and Kopp in pure chemistry, his inclination led him towards the literary side of his favourite studies, and it is on his accomplishments as an author that his fame chiefly rests. Still, as an investigator Wagner possessed remarkable and many-sided aptitudes, and his name is associated with numerous researches, the majority of which aim at the practical application of scientific facts, or seek to ascertain the chemical nature of important industrial products. One of his first investigations (1847) was on yeast, and included a thorough study of its nature and growth, and especially of the influence exercised by the presence of foreign bodies on the phenomena of fermentation. In 1849 he commenced a research on the oil of rue, which was carried on at various intervals, and to which we owe much of our knowledge of the constituents of this important essence. In 1850 he assigned to the alkaloïd conine the structure of a dibutyryl-amine, a formula verified long after by Schiff's synthesis (1871) of paraconine, and by Michael and Gundelach's brilliant synthesis a few months since, of methyl-conine. Among other noteworthy theoretical results, mention may be made of his extensive monograph on polymeric isomorphism (1851), and his experiments in the same year establishing the nature of mercur-ammonium compounds as substituted ammonias—mercury replacing hydrogen—by a distillation of the well-known "white precipitate" with amyl-mercaptan, which yielded sulphide of mercury and hydrochloride of amylamine. Shortly after he showed that the compounds imperatorin and peucedonine obtained from the roots of sulphur-wort and allied plants were identical, and established their chemical nature as angelate of the hydrate of peucedyle. One of Wagner's most important researches, commenced in 1850 and taken up several times since, had for an object the colouring-matters of fustic. In its course he discovered morin-tannic acid, which in company with morin gives to fustic wood its tinctorial properties. He studied carefully its reactions and its derivatives; and among the latter discovered pyrocatechin, the product of the destructive distillation of the acid. In 1853 he undertook a thorough examination of the oil of hops, separating the different chemical components, and finding amongst them quercitrin and morin-tannic acid. At this epoch he succeeded in obtaining the remarkable alloy formed by the union of four parts of potassium with 2½ parts of sodium, which is liquid at ordinary temperatures, and resembles mercury in appearance. In 1867 he contributed an interesting research on the rapid increase of solubility of carbonates in water containing carbonic acid under various pressures. At the same time he broached a theory of the formation of deposits of a graphite, in which he attributed it to a decomposition of cyanides in nature analagous to that occurring in the manufacture of soda. Among his more important analytical researches were the determinations (1860) of the quantities of oil present in the nuts and seeds of many forest trees. As an able deviser of analytical methods Wagner exhibited numerous proofs. Among these mention may be made of the use of the iodine reaction for analysing chlorides of lime (1859), the use of iodine likewise for the determination of the alkaloïds (1861), the volumetric deter-

mination of tannic acid by means of sulphate of cinchonine (1866), the test for wool in silk fabrics by using nitro-prusside of sodium to show the presence of the sulphur contained in wool (1867), the application of ammonium vanadate to detect the presence of tannin in red wines (1877), and other tests for detecting methyl-eosine in the presence of eosine, nitrobenzene in the oil of bitter almonds, paraffine in bees-wax, stearic acid in paraffine, &c. Equally numerous were the improved methods of preparing chemical compounds and products introduced by him, including the preparation of pelargonate of ethyl, used extensively in perfumery, of finely-divided copper, of rufigallic acid, of calcium iodide, of precipitated alumina, of chloride of mercury, of arsenate of sodium, of benzoic acid, &c.

Among Wagner's purely technical researches reference may be made to the application of pyrocatechin for photographic purposes (1855), the determination of densities for technical use (1859), the method for purifying water for tinctorial purposes (1863), the use of paraffine for preserving sodium, and his important research (1877) on the reactions of vanadium compounds with a large variety of organic commercial products, in the course of which he obtained several important tinctorial results.

As an author Prof. von Wagner has manifested a degree of talent and a fertility surpassed by but few of his scientific contemporaries. An easy, lucid style, an intimate familiarity with the entire range of subjects touched upon, a fulness of detail united to a logical, systematic treatment of the matters in question, and a happy adaptation to the wants of even elementary knowledge, have rendered his works universal favourites. This is especially true of his "Handbook of Chemical Technology," which has survived a twelfth edition in Germany, and has been rendered accessible to French and English-speaking students by the masterly translations of Gautier and Crookes. It is doubtful whether in any other branch of applied science a manual exists which is so widely disseminated and has met with such practically universal success. Among Wagner's other works are: "Die Chemie" (1860; sixth edition 1873), "Theorie und Praxis der Gewerbe," 5 vols. (1857-64), "Die chemische Fabrikindustrie," second edition (1869), "Regesten der Sodafabrikation" (1866), and "Studien auf der Pariser Ausstellung" (1868). The technical journals of the past thirty years contain numerous monographs from his pen on individual branches of chemical manufacture, full of valuable information and statistics obtained by Wagner from private sources, and replete with those fruitful suggestions natural to a mind familiar at once with the facts of science and with their widespread applications. Unquestionably Wagner's chief literary achievement is his celebrated "Jahresbericht über die Leistungen der chemischen Technologie." Started eight years after the appearance of Liebig and Kopp's well-known "Jahresbericht" for chemistry in all its departments, this work of Wagner's has for a quarter of a century kept the industrial and scientific world promptly, thoroughly, and accurately informed of the progress made in every branch of applied chemistry. In its fulness and exactness it is an admirable type of the annual review, now regarded as indispensable for every branch of human activity by the German mind; and the vast influence which it has exercised upon the development of chemical industries is impossible to measure. The "Jahresbericht" for 1879, recently issued, forms a portly volume of 1,300 pages, with over one hundred woodcuts, and in its reviews evidences at every step a critical spirit able to cope with the scientific and practical questions constantly evoked.

Personally Prof. von Wagner was of a most attractive disposition, admired by his students not only for his rare talents as a lecturer, but also for his amiable character. His loss is felt as severely in a widespread social circle as in the world of science. T. H. N.

JAPAN[1]

II.

MISS BIRD'S work on Japan, as we have said, is cast in quite a different mould from that of Sir Edward Reed. With the exception of one or two chapters, she devotes her two volumes entirely to a record of her own experiences, casting them as in her well-known books on the Sandwich Islands and the Rocky Mountains, into the form of a series of letters. These have evidently been written in the midst of the experiences which they record, and this gives them a reality and a freshness which they could not have otherwise had. Her "Unbeaten Tracks in Japan" has all the best characteristics of her book on the Sandwich Islands. Indeed it seems to us that for the majority of readers it will have far more of novelty and quite as much interest as any of her previous works, while we doubt if any other book on Japan yet published gives so full and real an insight into the everyday life and the condition of the bulk of the people. Her work well deserves the title it bears. Many of the districts into which she, amidst all sorts of difficulties, succeeded in penetrating were certainly never before visited by a European woman, if indeed by a European of either sex. Sir E. Reed speaks of the people along parts of his route rushing out to see the "Chinese" pass; but so strange and literally uncouth did Miss Bird's appearance seem in some districts that the people could only set her down as an "Aino." She of course saw all the usual sights in the usual tracks, all that Sir Edward Reed saw; and for this her intimacy with Sir Harry Parkes and his universally beloved lady procured her every facility. The result is not the almost unmixed admiration which we find in Sir Edward Reed's volumes; but then it should be remembered that she was not the guest of the Japanese Government, but practically of the representative of the English Government; and although Miss Bird is a thoroughly independent observer, still her opinions may have taken somewhat of their colour from her special surroundings. She states fully both sides of the question of Japanese progress, and while giving full credit to the Government for the best intentions, and admitting that vast progress has been made in recent years, still she has many drawbacks to point out. And no wonder; we fear that she, like some others who write on Japan, look for too much, and expect to find a Europe in the East, instead of a country struggling out of the bonds that swaddled it till only fifteen years ago. Still her criticisms are wholesome, and charitable, and good-natured, and we trust that they will come under the notice of those to whom, if taken in good part, they might be greatly beneficial. Miss Bird has much to say on the work of missionaries in Japan, but that is a subject into which we cannot enter here. She spent much of her time in the great centres among missionaries, and had ample opportunities of seeing the nature of the work they are doing. And her observations are of the greatest interest, and must be instructive to those who are hoping that the Japanese will ultimately put on the religious habiliments which have been shaped for centuries to the people of the West. One unfortunate result we may mention, and that is the deterioration of the manners of those who have been long under missionary influence. Surely this is not necessary.

Of course the great interest of Miss Bird's book is connected with her solitary journey, quite unhampered by official guidance, north through the centre of the Main Island, and most of all her sojourn in Yezo among the strange remnant of people known as Ainos. Her journey

[1] "Japan: its History, Traditions, and Religions, with the Narrative of a Visit in 1879." By Sir Edward J. Reed, K.C.B., F.R.S., M.P. Two vols. With Map and Illustrations. (London: John Murray, 1880.) "Unbeaten Tracks in Japan." By Isabella L. Bird. Two vols. With Map and Illustrations. (Same Publisher.) Continued from vol. xxii. p. 614.

through the Main Island gives us the other side of the picture to that seen in such well-known centres as Tokio, Yokohama, and Kioto—by far the finest city in Japan, the home of art and culture, according to Miss Bird. She gives very sad and sometimes very disgusting pictures of the condition of the people in some parts of the country through which she passed with her amusing and clever guide Ito. In one district the villages, she tells us, have reached the lowest abyss of filthiness; still she found the people here, as everywhere else, courteous, kindly, industrious, and free from gross crimes. Indeed, although naturally an object of intense interest wherever she went, and the centre of hundreds and sometimes thousands of eyes, she had rarely if ever to complain of discourtesy. Everywhere everybody was courteous and obliging, and except in the open towns, rarely was an attempt at extortion made. While part of the centre of the island is dreary enough, much of it is of the rarest beauty, with its fine mountains, rich woods, and rapid deeply cutting rivers. At Niigata and other open ports she notes with satisfaction the rapid spread of European medical treatment under the care of the medical missionaries, some of whom are doing excellent work. At Niigata, especially Dr. Palm's influence is wide-spread, and thousands of people have been weaned from the Chinese system of treatment to that offered by Dr. Palm and his numerous native assistants, most of them men of the best type, who have established among themselves a society similar to some of the medical societies which meet in London and elsewhere. At Niigata Miss Bird made the acquaintance of an interesting bookseller. "This bookseller, who was remarkably communicative, and seems very intelligent, tells me that there is not the same demand now as formerly for native works on the history, geography, and botany of Japan. He showed me a folio work on botany in four thick volumes, which gives root, stalk, leaf, flower, and seed of every plant delineated (and there are 400), drawn with the most painstaking botanical accuracy, and admirable fidelity to colour. This is a book of very great value and interest. He has translations of some of the works of Huxley, Darwin, and Herbert Spencer, which, he says, are bought by the young men attending the higher school. The 'Origin of Species' has the largest sale. This man asked me many questions about the publishing and bookselling trade in England, and Ito acquitted himself admirably as an interpreter. He had not a single book on any subject connected with religion."

In a letter from Kaminoyama, to the north-east of Niigata, she gives a graphic picture of the incongruities to be met with in the present transition state of the country:—"We rode for four hours through these beautiful villages on a road four feet wide, and then, to my surprise, after ferrying a river, emerged at Tsukuno upon what appears on the map as a secondary road, but which is in reality a main road twenty-five feet wide, well kept, trenched on both sides, and with a line of telegraph poles along it. It was a new world at once. The road for many miles was thronged with well-dressed foot-passengers, *kurumas*, pack-horses, and waggons either with solid wheels, or wheels with spokes but no tires. It is a capital carriage-road, but without carriages. In such civilised circumstances it was curious to see two or four brown-skinned men pulling the carts, and quite often a man and his wife—the man unclothed, and the woman unclothed to her waist—doing the same. Also it struck me as incongruous to see telegraph wires above, and below, men whose only clothing consisted of a sun-hat and fan; while children with books and slates were returning from school, conning their lessons."

As far north as Kubota, quite 200 miles north of Niigata, Miss Bird found a normal school established, with twenty-five teachers and 700 pupils between the ages of six and twenty. "They teach reading, writing, arithmetic, geography, history, political economy after John Stuart Mill, chemistry, botany, a course of natural science, geometry, and mensuration." Indeed she found evidence everywhere of the schoolmaster being abroad all over the country, and of the purpose of the Government to make education, after the models of Europe and America, universal and compulsory; and among the educated classes, the familiarity with the works of the most advanced English scientific writers—Huxley, Darwin, and Spencer especially—struck her greatly.

FIG. 1.—Ainos of Yezo.

To the ethnologist Miss Bird's notes on the Ainos, the

aborigines of the Island of Yezo, and possibly of all Japan, will prove of special interest. We already know much about the physique and the habits of these strange people; but Miss Bird's notes of what she saw and heard during the weeks she lived in their houses, saw their daily life, heard what they had to say of themselves, their history, and their superstitions, are a real addition to our existing knowledge of them. As usual all sorts of things were said by people in Hakodaté to prevent her from trusting herself alone among these uncivilised people, but Miss Bird took her own womanly way, and was rewarded. These Ainos she found of fierce outer aspect, with their long shaggy hair and beards, broad faces, and rough bodies, but in speech and manner gentler than the gentlest Hawaiian. Their soft and feminine speech constantly struck her, and in genuine politeness they are not surpassed by the Japanese. Here is a picture of Aino domestic life:—

FIG. 2.—Aino Houses.

FIG. 3.—Ainos at home (From a Japanese sketch).

"I am in the lonely Aino land, and I think that the most interesting of my travelling experiences has been the living for three days and two nights in an Aino hut, and seeing and sharing the daily life of complete savages' who go on with their ordinary occupations just as if I were not among them. I found yesterday a most fatiguing and over-exciting day, as everything was new and interesting, even the extracting from men who have few if any ideas in common with me, all I could extract concerning their religions and customs, and that through an interpreter. I got up at six this morning to write out my notes, and have been writing for five hours, and there is shortly the prospect of another savage *séance*. The distractions, as you imagine, are many. At this moment a savage is taking a cup of *saké* by the fire in the centre of the floor. He salutes me by extending his hands and waving them towards his face, and then dips a rod in the *saké*, and makes six libations to the god—an upright piece of wood with a fringe of shavings planted in the floor of the room. Then he waves the cup several times towards himself, makes other libations to the fire, and drinks. Ten other men and women are sitting along each side of the fire-hole, the chief's wife is cooking, the men are apathetically contemplating the preparation of their food; and the other women, who are never idle, are splitting the bark of which they make their clothes. I occupy the guest seat—a raised platform at one end of the fire, with the skin of a black bear thrown over it."

These Ainos drink enormous quantities of *saké*, the national liquor of Japan; they can drink three times as much as a Japanese without being affected by it, and the drinking of it is with them the chief act of worship to the rude gods, if gods they be, which are stuck up in various parts of their huts. Here is another picture:—

"About nine the stew was ready, and the women ladled it into lacquer bowls with wooden spoons. The men were served first, but all ate together. Afterwards *saké*, their curse, was poured into lacquer bowls, and across each bowl a finely-carved '*saké-stick*' was laid. These sticks are very highly prized. The bowls were waved several time with an inward motion, then each man took his stick and, dipping it into the *saké*, made six libations to the fire, and several to the 'god,' a wooden post, with a quantity of spiral white shavings falling from near the top."

The intense fondness of the Ainos for their children is a marked feature in their character, and the instantaneous and implicit obedience of the latter to their parents is as great as with the Japanese themselves. Their hospitality is genuine, universal, and almost profuse. "In every house the same honour was paid to a guest. This seems a savage virtue which is not strong enough to survive much contact with civilisation. Before I entered one lodge the woman brought several of the finer mats, and arranged them as a pathway for me to walk to the fire upon. They will not accept anything for lodging or for anything that they give, so I was anxious to help them by buying some of their handiwork, but found even this a difficult matter. They were very anxious to give, but when I desired to buy they said they did not wish to part with their things. I wanted what they had in actual use, such as a tobacco-box and pipe-sheath, and knives with carved handles and scabbards, and for three of these I offered $2\frac{1}{2}$ dollars. They said they did not care to sell them, but in the evening they came saying they were not worth more than 1 dollar 10 cents, and they would sell them for that; and I could not get them to take more. They said it was 'not their custom.'"

All that Miss Bird tells us of her visit to the Ainos is well worth quoting; but we have space for only one more quotation, and that with reference to their physique:—

"After the yellow skins, the stiff horse hair, the feeble eyelids, the elongated eyes, the sloping eyebrows, the flat noses, the sunken chests, the Mongolian features, the puny physique, the shaky walk of the men, the restricted totter of the women, and the general impression of degeneracy conveyed by the appearance of the Japanese, the Ainos make a very singular impression. All but two or three that I have seen are the most ferocious-looking of savages, with a physique vigorous enough for carrying out the most ferocious intentions, but as soon as they speak the countenance brightens into a smile as gentle as that of a woman, something which can never be forgotten. The men are about the middle height, broad-chested, broad-shouldered, 'thick-set,' very strongly built, the arms and legs short, thick, and muscular, the hands and feet large. The bodies, and specially the limbs, of many are covered with short bristly hair. I have seen two boys whose backs are covered with fur as fine and soft as that of a cat. The heads and faces are very striking. The foreheads are very high, broad, and prominent, and at first sight give one the impression of an unusual capacity for intellectual development; the ears are small and set low; the noses are straight, but short, and broad at the nostrils; the mouths are wide, but well formed; and the lips rarely show a tendency to fulness. The neck is short, the cranium rounded, the cheek-bones low, and the lower part of the face is small as compared with the upper, the peculiarity called a 'jowl' being unknown. The eyebrows are full, and form a straight line nearly across the face. The eyes are large, tolerably deeply set, and very beautiful, the colour a rich liquid brown, the expression singularly soft, and the eyelashes long, silky, and abundant. The skin has the Italian olive tint, but in most cases is thin, and light enough to show the changes of colour in the cheek. The teeth are small, regular, and very white; the incisors and 'eye teeth' are not disproportionately large, as is usually the case among the Japanese; there is no tendency towards prognathism; and the fold of integument which conceals the upper eyelids of the Japanese is never to be met with. The features, expression, and aspect are European rather than Asiatic.

"The 'ferocious savagery' of the appearance of the men is produced by a profusion of thick soft black hair, divided in the middle, and falling in heavy masses nearly to the shoulders. Out of doors it is kept from falling over the face by a fillet round the brow. The beards are equally profuse, quite magnificent, and generally wavy, and in the case of the old men they give a truly patriarchal and venerable aspect, in spite of the yellow tinge produced by smoke and want of cleanliness. The savage look produced by the masses of hair and beard, and the thick eyebrows, is mitigated by the softness in the dreamy brown eyes, and is altogether obliterated by the exceeding sweetness of the smile, which belongs in greater or less degree to all the rougher sex.

"I have measured the height of thirty of the adult men of this village, and it ranges from 5 feet 4 inches to 5 feet 6½ inches. The circumference of the heads averages 22·1 inches, and the arc, from ear to ear, 13 inches. According to Mr. Davies the average weight of the Aino adult masculine brain, ascertained by measurement of Aino skulls, is 45·90 ounces avoirdupois, a brain weight said to exceed that of all the races, Hindoo and Mussulman, on the Indian plains, and that of the aboriginal races of India and Ceylon, and is only paralleled by that of the races of the Himalayas, the Siamese, and the Chinese Burmese. Mr. Davies says, further, that it exceeds the mean brain weight of Asiatic races in general. Yet with all this the Ainos are a stupid people!"

The coast Ainos, Miss Bird tells us, she found had more hair on their bodies than those in the interior, and in some other respects differed in appearance, a difference probably to be accounted for by their mode of life and their surroundings. The Aino garments are often exceedingly handsome, being decorated with "geometrical" patterns in which the Greek fret takes part, in coarse blue cotton, braided most dexterously with scarlet and white thread. The modesty of the women is very remarkable, sometimes almost excessive even to European notions; nor do they seem to be the unmitigated drudges that most savage women are. The great hero of the Ainos is Yoshitsuné, who is also the most popular hero of Japanese history; the Ainos worship him, and Miss Bird was permitted to visit his shrine on a hill near Biratori, the Aino village at which she spent most of her time. He lived in the twelfth century, and was the brother of the Shôgun of the time, whose jealousy, according to some, compelled him to take refuge in Yezo. "None believe this more firmly than the Ainos themselves, who assert that he taught their fathers the arts of civilisation, with letters and numbers, and gave them righteous laws, and he is worshipped by many of them under a name which signifies Master of the Law. I have been told by old men in Biratori, Usu, and Lebungé, that a later Japanese conqueror carried away the books in which the arts were written, and that since his time the arts themselves have been lost, and the Ainos have fallen into their present condition! On asking why the Ainos do not make vessels of iron and clay as well as knives and spears, the invariable answer is, 'The Japanese took away the books.'" This, combined with some other things which Miss Bird tells us of these Ainos, makes it seem quite possible that they are now a degenerate remnant of a people who formerly were comparatively cultured, and who may possibly have had "books" which the Japanese, their conquerors and masters, "took away." These strange people are certainly worthy of further study. The illustrations we are able to give, by the kindness of Mr. Murray, will give the reader some idea of their appearance and habits. We strongly recommend the reader to go to Miss Bird's volumes for further information of what she saw and heard while sojourning among them.

Again we commend these two works to all who desire to get, in comparatively short space, a very complete view of the past history and present condition of Japan.

BELL'S PHOTOPHONE

By the courtesy of Prof. Graham Bell we are at length able to do somewhat ampler justice to his latest discovery than has hitherto been possible. He has supplied us with certain details not hitherto published, and has also furnished us with drawings of his apparatus and experiments. Prof. Bell is at present in Paris, and, as was mentioned in our columns last week, has there repeated some of his experiments.

Our readers are already aware that the object of the photophone is the transmission of sounds both musical and vocal to a distance by the agency of a beam of light of varying intensity; and that the first successful attempts made by Prof. Bell and his co-labourer, Mr. Sumner Tainter, were based upon the known property of the element selenium, the electric resistance of which varies with the degree of illumination to which it is exposed. Hence, given a transmitting instrument such as a flexible mirror by which the vibrations of a sound could throw into vibration a beam of light, a receiver consisting of sensitive selenium forming part of an electric circuit with a battery and a telephone should suffice to translate the varying intensities of light into corresponding varying intensities of electric current, and finally into vibrations of the telephone disk audible once more as *sound*. This funda-

mental conception dates from 1878, when in lecturing before the Royal Institution Prof. Bell announced the possibility of hearing a shadow fall upon a piece of selenium included in a telephone circuit. The photophone, however, outgrew the particular electrical combination that suggested it; for not the least of the remarkable points in this research is the discovery that audible vibrations are set up in thin disks of almost every kind of

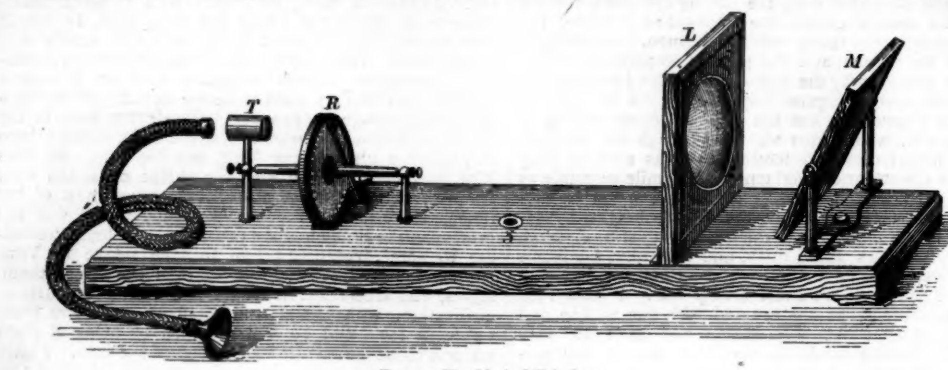


FIG. 1.—The Musical Telephone.

material by merely throwing upon them an intermittent light. Hence in theory, if not in practice, the receiver may be reduced to the divine simplicity of a mere disk of

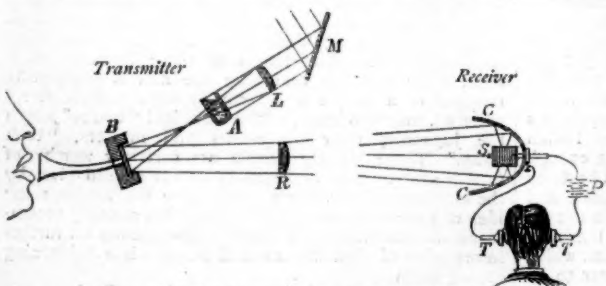


FIG. 2.—Theoretical Diagram of the Articulating Photophone.

vulcanite or of zinc, on one side of which the vibrating beam of light falls, and at the other side of which the hearer listens.

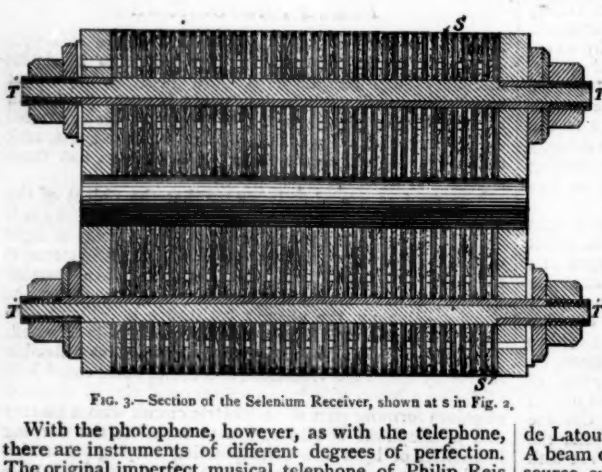


FIG. 3.—Section of the Selenium Receiver, shown at S in Fig. 2.

With the photophone, however, as with the telephone, there are instruments of different degrees of perfection. The original imperfect musical telephone of Philip Reis could only transmit musical tones, because it worked by rapid abrupt interruptions of the electric current; while the articulating telephone of Graham Bell was able to transmit speech, since by its essential construction it was able to send undulating currents to the distant receiving station.

We may in like manner classify the forms of photophone under two heads, as (1) articulating photophones, and (2) musical photophones; the former being able to transmit speech because they work by beams of light whose intensity can vary in undulatory fluctuations, like those of vocal tones; the latter being able to transmit simple musical tones only, since they work by mere interruptions of a fixed beam of light.

Up to the present time, Prof. Bell informs us, the simple receiving disk of ebonite or hard rubber has only served for a musical photophone: the reproduction of the tones of the voice by its means has not yet been demonstrated in practice—at least to his satisfaction. For while it produces unmistakable musical tones by the direct action of an intermittent light, in the experiments made hitherto with articulate speech the instruments have by necessity been so near to one another that the voice of the speaker was audible through the air. Under these circumstances it is extremely difficult to say whether the sounds that are heard proceed from the diaphragm, or whether they merely came through the air to the ear, and if they come from the diaphragm, whether they are really the result of the varying light, and not mere sound vibrations taken up by the disk from the speaker's voice crossing the air. Prof. Bell hopes soon to settle this point, however, by an appeal to experiment on a larger scale with the receiving and transmitting instruments at greater distances apart, and with glass windows in between to shut off all sounds.

In Fig. 1 we illustrate the simple musical photophone of Bell and Tainter. It might perhaps be described without injustice as an *optical siren*, producing sounds from intermittent beams of light, as the *siren* of Cagniard de Latour produces them from intermittent puffs of air. A beam of light from the sun or from a powerful artificial source, such as an electric lamp, falls upon a mirror M, and is reflected through a large lens L, which concentrates

the rays to a focus. Just at the focus is interposed a disk pierced with holes—forty or so in number—arranged in a circle. This disk can be rotated so that the light is interrupted from one to five or six hundred times per second. The intermittent beam thus produced is received by a lens T, or a pair of lenses upon a common support, whose function is to render the beam once more parallel, or to concentrate it upon the disk of ebonite placed immediately behind, but not quite touching them. From the disk a tube conveys the sounds to the ear. We may remind our readers here that this apparent direct conversion of light into sound takes place, as Prof. Bell found, in disks of all kinds of substances—hard rubber, zinc, antimony, selenium, ivory, parchment, wood, and that he has lately found that disks of carbon and of thin glass, which he formerly thought exceptions to this property, do also behave in the same way. We may perhaps remark without impropriety that it is extremely improbable that the apparent conversion of light into sound is by any means a direct process. It is well known that luminiferous rays, when absorbed at the surface of a medium, warm that surface slightly, and must therefore produce physical and molecular actions in its structure. If it can be shown that this warming effect and an intermediate cooling by conduction can go on with such excessive rapidity that beams of light falling on the surface at intervals less than the hundredth of a second apart produce a discontinuous molecular action of alternate expansion and contraction, then the mysterious property of matter revealed by these experiments is accounted for.

However this may be, the musical photophone, as represented in Fig. 1, produces very distinct sounds, of whose existence and dependence for their production on the light the listener may satisfy himself by cutting off the light at any moment with the little opaque disk fixed on the end of the little lever just in front of the holes in disk R, and which can be worked by a Morse key like a telegraph instrument, thus producing at will alternate sounds and silences. With this musical photophone sounds have been carried by an interrupted beam of light for a distance exceeding a mile; there appears, indeed, no reason why a much greater range might not be attained.

The articulating photophone is that to which hitherto public attention has been most largely directed, and in which a selenium receiver plays a part. Fig. 2 gives in diagram form the essential parts of this arrangement. A mirror M reflects a beam of light as before through a lens L, and (if desired for the purpose of experimentally cutting off the heat-rays) through a cell A containing alum-water, and casts it upon the transmitter B. This transmitter, shown again in Fig. 5, consists of a little disk of thin glass, silvered on the front, of about the size of the disk of an ordinary telephone, and mounted in a frame, with a flexible india-rubber tube about sixteen inches long leading to a mouthpiece. A second lens R, interposed in the beam of light after reflection at the little mirror, renders the rays approximately parallel. The general view of the transmitting apparatus given in Fig. 5 enables the relative sizes and positions of the various parts (minus the alum-cell which is omitted) to be seen. The screw adjustments of the support serve to direct the beam of light in the desired direction.

It may be well to explain once for all *how* the vibrations of the voice can affect the intensity of the reflected beam far away. The lenses are so adjusted that when the mirror B is flat (*i.e.* when not vibrating) the beam projected from the apparatus to the distant station shall be nearly focussed on the receiving instrument. Owing to the optical difficulties of the problem it is impossible that the focussing can be more than approximate. Now, matters being thus arranged, when the speaker's voice is thrown against the disk B it is set into vibration, becomes alternately bulged out and in, and made slightly convex or concave, the degree of its alteration in form varying with every vibration of the voice. Suppose at any instant—say by a sudden displacement such as takes place when the letter "T" is sounded—the disk becomes considerably convex; the beam of light will no longer be concentrated upon the receiving instrument, but will cover a much wider area. Of the whole beam, therefore, only a relatively small portion will fall upon the receiving instrument; and it is therefore possible to conceive that, if perfectly adjusted, the illumination should be proportional to the displacement of the disk, and vary therefore with every vibration with the utmost fidelity.

The receiver of the articulating photophone is shown on the right-hand side of the diagram (Fig. 2) sketched by Prof. Bell. A mirror of parabolic curve C C serves to concentrate the beam and to reflect it down upon the selenium cell S, which is included in the circuit of a battery P along with a pair of telephones T and T. Here again a general view like that given in Fig. 6 facilitates the comprehension of the principal parts of the apparatus. The sensitive selenium cell is seen in the hollow of the parabolic mirror which is mounted so as to be turned in any desired direction. The battery standing upon the ground furnishes a current which flows through the selenium cell and through the telephones. When a ray of light falls on the selenium—be it for ever so short an instant—the selenium increases in conductivity, and instantly transmits a larger amount of electricity, and the observer with the telephones hears the ray, or the succession of them;—hears

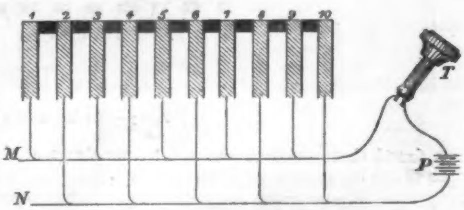


FIG. 4.—Diagram to show the action of the Selenium Receiver.

indeed their every fluctuation in a series of sounds which, since each vibration corresponds to a vibration of the voice of the distant speaker, reproduce the speaker's tones.

The great difficulty to be overcome in the use of selenium as a working substance arose from its very high resistance. To reduce this to the smallest possible quantity, and at the same time to use a sufficiently large surface whereon to receive the beam of light, was the problem to be solved before any practical result could be arrived at. After many preliminary trials with gratings and perforated disks of various kinds, Prof. Bell and Mr. Tainter finally settled upon the ingenious device to be described. A number of round brass disks, about two inches in diameter, and a number of mica disks of a diameter slightly less, were piled upon one another so as to form a cylinder about two and a half inches in length. They were clamped together from end to end, the clamping rods also serving to unite the disks of brass electrically in two sets, alternate disks being joined, the 1st, 3rd, 5th, &c., being united together, and the 2nd, 4th, 6th, &c., being united in another series. This done, the edges between the brass disks were next filled with seleninum, which was rubbed in at a temperature sufficiently high to reach the melting-point of selenium. After this the selenium was carefully annealed to bring it into the sensitive crystalline state. Then the cell is placed in a lathe and the superfluous selenium is turned off until the edges of the brass disks are bared. Fig. 3 shows, in section, the construction of such a cell. Prof. Bell has also used cells in which the selenium filled only the *alternate* spaces between disks, the intermediate spaces being occupied by

mica disks of equal diameter with the brass disks. But this arrangement was in no way preferable, for in practice it was found that moisture was apt to penetrate at the surface of the bare mica, spoiling the effect.

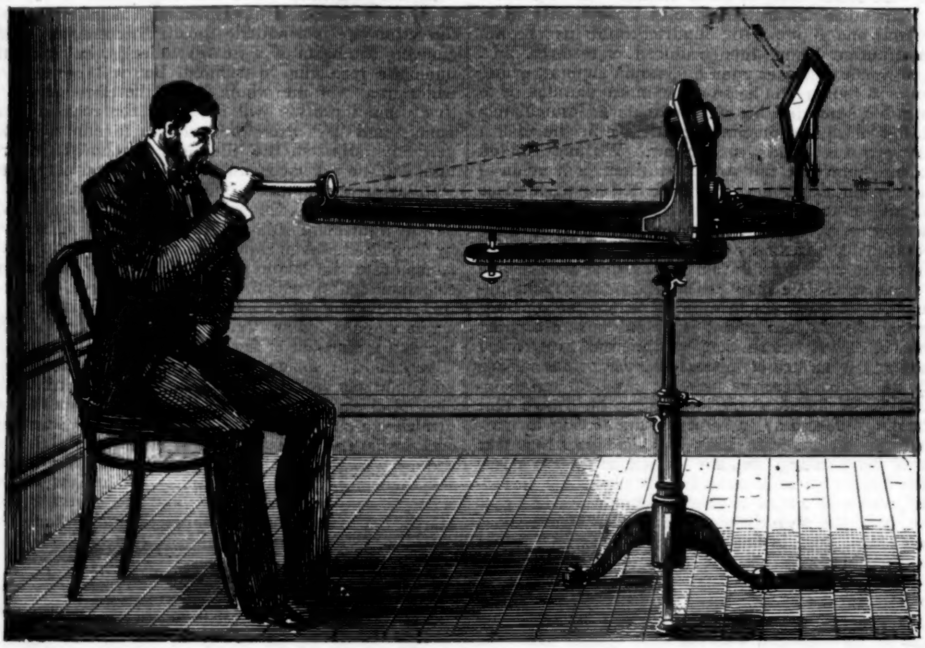


FIG. 5.—The Articulating Photophone. The Transmitter.

Fig. 4 is a diagram which simply illustrates the action of the selenium receiver, and shows, firstly, the way of connecting the alternate disks; and secondly, that the current from the battery P cannot go round the telephone

FIG. 6.—The Articulating Photophone. The Selenium Receiver.

circuit without passing somewhere through selenium from one brass disk to the next. The special advantages of the "cell" devised by Prof. Bell are that in the first place the thickness of the selenium that the current must traverse is nowhere very great; that in the second, this photo-electrical action of light on selenium being almost entirely a *surface* action, the arrangement by which all the selenium used is a thin surface film could hardly be improved upon; and that thirdly, the symmetry of the cylindrical cell specially adapts it for use in the parabolic mirror. These details will be of great interest especially to those who desire to repeat for themselves the experimental transmission of sound by light. The greatest distance to which articulate speech has yet been transmitted by the selenium-cell-photophone is 213 metres, or 233 yards.

When sunlight is not available recourse must be had to an artificial source of sufficient power. During the recent experiments made by Prof. Bell in Paris the weather has been adverse, and the electric light has been called into requisition in the *ateliers* of M. Bregnet (Fig. 7, which is kindly supplied us by Prof. Bell). The distance in these experiments between the transmitting diaphragm B and the parabolic reflector C C of the receiver was fifteen metres, the entire length of the room in which

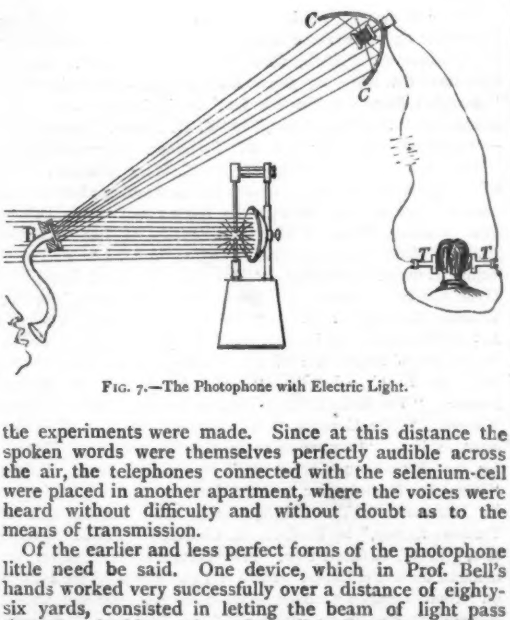


FIG. 7.—The Photophone with Electric Light.

the experiments were made. Since at this distance the spoken words were themselves perfectly audible across the air, the telephones connected with the selenium-cell were placed in another apartment, where the voices were heard without difficulty and without doubt as to the means of transmission.

Of the earlier and less perfect forms of the photophone little need be said. One device, which in Prof. Bell's hands worked very successfully over a distance of eighty-six yards, consisted in letting the beam of light pass through a double grating of parallel slits lying close to one another, one of which was fixed, the other movable and attached to a vibrating diaphragm. When these were placed exactly one in front of the other the light could traverse the apparatus, but as the movable grating slid more or less in front of the fixed one more or less of the light was cut off. Speaking to the diaphragm therefore caused vibrations which shut or opened, as it were, a door for the beam of light, and altered its intensity. The mirror transmitter of thin glass silvered was however found superior to all others; and it is hard to see how it could be improved upon, unless possibly by the use of a thin disk of silver itself accurately surfaced and polished.

Whatever be the future before the photophone, it assuredly deserves to rank in estimation beside the now familiar names of the telephone and the phonograph.

NOTES

THE Triennial Gold Medal of the Chemical Section of the Philosophical Society of Glasgow, founded in commemoration of the work of Thomas Graham, F.R.S., late Master of the Mint, will be awarded, at the end of the present session, for the best paper on any subject in pure or applied chemistry. Authors are requested to send in their papers not later than February 1, 1881, addressed to the Secretary of the Section, Dr. J. J. Dobbie, Chemical Laboratory, University of Glasgow.

THE annual meeting of the five academies which constitute the French Institute was held on Monday last week, when M. E. Levasseur gave an address on the Ethnography of France, and Col. Perrier described the operation he undertook to connect geodetically Algeria and Spain.

THE Royal Institution Lecture arrangements (not yet complete) for the ensuing season (before Easter) will include the Christmas course by Prof. Dewar; and courses by Professors Tyndall and Schäfer, the Rev. William Haughton, the Rev. H. R. Haweis, Mr. H. H. Statham, Mr. Reginald S. Poole, and others. Friday Evening Discourses will probably be given by Mr. Warren De La Rue, Prof. Tyndall, Sir John Lubbock, Sir William Thomson, Dr. J. Burdon Sanderson, Dr. Andrew Wilson, Dr. Arthur Schuster, Mr. Alexander Buchan, Dr. W. H. Stone, Dr. W. J. Russell.

THE death is announced of Sir Thomas Bouch, the engineer of the Tay Bridge. It is believed that his system received a severe shock on account of the Tay Bridge disaster and the proceedings consequent on it.

M. ERHARD, the well-known French cartographer, died on October 23. M. Erhard was a naturalised Frenchman, having been born at Freiburg-im-Breisgau.

AMONG Mr. Stanford's announcements of forthcoming works are the following:—"Prehistoric Europe: a Geological Sketch," by Dr. James Geikie, F.R.S.; a fourth edition of "The Coal-Fields of Great Britain," by Prof. Edward Hull, F.R.S.; "Life and her Children: Glimpses of Animal Life from the Amœba to the Insects," by Arabella B. Buckley; "Index Geographicus Indicus: a Gazetteer of India," by J. F. Barness; "The Flora of Algeria, considered in Relation to the Physical History of the Mediterranean Region and Supposed Submergence of the Sahara," by W. Mathews; "Water Supply of England and Wales: its Geology, Underground Circulation, Surface Distribution, and Statistics," by C. E. de Rance.

IN the November number of *Scribner's Monthly* is a curious article on Second Sight or Clairvoyance, by an "Ex-Conjuror" (Mr. Henry Hatton), in which it is shown that the whole thing is an elaborate system of mnemonics. The article has all the appearance of being genuine.

IN reference to the notice in NATURE, vol. xxii. p. 587, on the address of Dr. Karl Zittel on the subject of the geology of the Libyan Desert, we should state that while the paper contains Zittel's opinions of the observations and collections of other travellers, it is mainly derived from the Professor's personal examination of the physiography of that country, and of the fossils which he there collected, when, as a member of the expedition under the leadership of Dr. Rohlfs, he visited the Libyan Desert in the winter of 1873-74.

THE lecture on "The Modifications of the External Aspects of Organic Nature produced by Man's Interference," delivered by Prof. Rolleston to the Royal Geographical Society in 1879, has just been published in that Society's *Journal*. Amongst other interesting matters Prof. Rolleston rectifies an error into which all or most translators of Cæsar have fallen respecting

the Scotch fir. Cæsar ("De Bello Gallico," v. 12) says of Britain, "Materia cujusque generis, ut in Gallia, est *præter fagum atque abietem*," which words have been generally taken to mean, "There is wood of all kinds to be found in Britain, as in Gaul, *except* the beech and the fir." The word *præter* however does not always mean "except," but sometimes "besides," as quotations from Cicero and Plautus aptly illustrate. Prof. Rolleston further remarks that "an historian who was or was not a professed botanist, might without any sensible man blaming him, speak nowadays of all the common pines 'Scotch,' 'umbrella,' 'cluster,' &c., as 'pines'; my present belief is that Julius would similarly have spoken of them all as *abietes*, and would probably have included the 'firs' proper under the same name as these 'pines.'"

AT the last meeting of the Epping Forest and County of Essex Naturalists' Field Club, held Saturday, October 30, it was announced that H.R.H. the Duke of Connaught, Ranger, had consented to become the Patron of the Club. Arrangements are being made to get up a course of winter science lectures in connection with the Club, the first of these being fixed for November 10, by Mr. J. E. Harting, who will lecture on "Forest Animals." It was further announced that a lecture had been promised during the session by Mr. A. R. Wallace.

PROF. BOYD DAWKINS has lately shown in his "Early Man in Britain" that "although the Neolithic men were immeasurably above the Cave-men in culture, they were far below them in the arts of design;" and further that the Cave-man "possessed a singular talent for representing the animals he hunted, and his sketches reveal to us that he had a capacity for seeing the beauty and grace of natural form not much inferior to that which is the result of long-continued civilisation in ourselves, and very much higher than that of his successors in Europe in the Neolithic age." That this faculty of design or artistic aptitude is still independent of advanced or advancing civilisation is shown by Dr. Holub in a paper "On the Central South African Tribes," just published in the *Journal* of the Anthropological Institute. Mr. Holub remarks in connection with the Bushmen, that these people "regarded as the lowest types of Africans, in one thing excel all the other South African tribes whose acquaintance I made between the south coast and 10° south latitude. I have in my possession about 200 sketches on wood and stone and ostrich shells, by various tribes, but every one who knows anything about drawing must acknowledge that those which were done by Bushmen are superior to any of the others."

IT is stated that some samples of a new seed and also of the native cucumber, collected in Central Australia by Mr. Vesey Brown, have been received at the Sydney Botanical Gardens. The former is a small black pea, which grows in pods similar to those of the ordinary pea; it is supposed to be edible, and resembles the nardoo. The cucumbers are about the size of walnuts, and are said to make an excellent pickle.

A RECENT report to the Foreign Office by Mr. Consul Crawford at Oporto on matters connected with the wine trade contains observations on the ravages of the parasitic insect, *Phylloxera vastatrix*, in the port wine district, and the means taken to avert them, and is illustrated by a sketch map of Northern Portugal, showing the progress of the disease.

AT the opening meeting of the Eastbourne Natural History Society on October 15, Mr. F. C. S. Roper read a paper on the additions to the fauna and flora of the Cuckmere district during the past year.

IN the Fourteenth Annual Report of the Aëronautical Society of Great Britain are papers on Aëronautics, by Mr. T. Moy, the "Mechanical Action of the Air," by Mr. Phillips; "Artificial Flight," by Mr. F. W. Brearey; "Aërial Propellers," by Mr. R. C. Jay.

VALPARAISO advices to August 21 give particulars of the earthquake of August 14. The *Chilian Times* says:—"The duration of the shock was nearly ninety seconds. No serious damage was done to buildings in Valparaiso. At Vina del Mar, one of the towers of the church fell and another was shaken out of its level, and will probably have to be pulled down. The roof of the Quillota parish church fell in. At Llaillai eighteen or twenty houses were destroyed. Illapel suffered very severely. One strange item reported is the occurrence of 'huracane de agua,' whatever they may be. The Governor of Illapel in his first telegram stated that three of these had burst in the Cordillera. Now it is stated that there were thirty observed. One paper spoke of them as 'water volcanoes.' From Coquimbo it is reported that high columns of water were thrown up from the bay. An *employé* of the Transandine Telegraph Company felt the shock while crossing the highest parts of the Andes. He states that it was the strongest earthquake he has ever felt."

A NAPLES telegram of November 2 states that Vesuvius is now very active; lava continues to flow from the crater, and present indications point to the probability of increased eruptive energy.

THE first meeting of the Society of Arts is announced for November 17, when the opening address will be delivered by F. J. Bramwell, F.R.S., Chairman of the Council. Before Christmas the following papers will be read:—November 24—"Barry's Influence on English Art," by J. Comyns Carr. December 1—"The Photophone," by W. H. Preece. December 8—"London Fogs," by Dr. A. Carpenter. December 15—"The Use of Sound for Signals," by E. Price Edwards. The following papers are down on the list for reading after Christmas:—"Buying and Selling: its Nature and its Tools," by Prof. Bonamy Price. "The Participation of Labour in the Profits of Enterprise," by Sedley Taylor, M.A., late Fellow of Trinity College, Cambridge. "The Gold Fields of India," by Hyde Clarke. "Flashing Signals for Lighthouses," by Sir William Thomson, F.R.S. "The Present Condition of the Art of Wood-carving in England," by J. Hungerford Pollen, "Ten Years' Experience of the Working of the Trade Mark Act," by E. C. Johnson. "Trade Prospects," by Stephen Bourne. "The Manufacture of Aërated Waters," by T. B. Bruce Warren. "The Compound Air Engine," by Col. F. Beaumont, R.E. "Improvements in the Treatment of Esparto for the Manufacture of Paper," by William Arnot, F.C.S. "Deep Sea Investigation, and the Apparatus used in it," by J. Y. Buchanan. "The Discrimination and Artistic Use of Precious Stones," by Prof. A. H. Church. "Indian Agriculture," by W. R. Robertson. Five courses of lectures are announced under the Cantor bequest: First course—Five lectures on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain," by Prof. A. C. Church. Second Course—Three lectures on "Watchmaking," by Edward Rigg, M.A. Third course—Four lectures on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Fourth course—Three lectures on "The Art of Lace-making," by Alan S. Cole. Fifth course—Three lectures on "Colour Blindness and its Influence upon Various Industries," by R. Brudenell Carter. The two Juvenile Lectures, for children of Members, during the Christmas holidays, will be by G. J. Romanes, F.R.S., on "Animal Intelligence." The arrangements for the "Indian," "Foreign and Colonial," and "Chemical and Physical" Sections will be announced after Christmas.

THE following is the title of the essay to which the "Howard Medal" of the Statistical Society will be awarded in November,

1881:—"On the Jail Fever, from the earliest Black Assize to the last recorded outbreak in recent times." The essays to be sent in on or before June 30, 1881. The Council have decided to grant the sum of 20*l.* to the writer who may gain the "Howard Medal" in November, 1881.

THE additions to the Zoological Society's Gardens during the past week include a Sykes's Monkey (*Cercopithecus albigularis*) from West Africa, presented by the Officers of the Royal Yacht; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. A. Haynes; a Rhesus Monkey (*Macacus erythræus*) from India, presented by the Rev. J. Saunders, B.A.; a Two-toed Sloth (*Cholopus didactylus*) from Demerara, presented by Mr. G. H. Hawtayne, C.M.Z.S.; an Egyptian Jerboa (*Dipus ægyptius*) from Egypt, presented by Major Money; a Common Trumpeter (*Psophia crepitans*) from Demerara, presented by Mr. J. Stovell; two Silver Pheasants (*Euplocamus nycthemerus*) from China, presented by Miss C. Hallett; an Indian Gazelle (*Gazella bennetti*) from India, deposited; an Ursine Dasyure (*Dasyurus ursinus*) from Tasmania, a Common Wigeon (*Mareca penelope*), a Grey Plover (*Squatareola helvetica*), a Knot (*Tringa canutus*), a Greenshank (*Totanus cadidris*), British, a Horned Ceratophrys (*Ceratophrys cornuta*) from Santa Marta, purchased.

OUR ASTRONOMICAL COLUMN

THE COMETS OF 1812 AND 1815.—We learn from M. Schulhof, of the Bureau des Longitudes, Paris, that in conjunction with M. Bossert he has undertaken a rigorous investigation of the orbit of the comet of 1812, which Encke showed to have a period of about seventy years, and which will consequently be again approaching its perihelion. M. Schulhof hopes to complete the calculations early in the ensuing year. He has discovered a series of original observations by Blanpain at Marseilles, which he considers to be amongst the best, if not the best series that are available; the original observations by Lindenau have also been received, but unfortunately nothing is to be found of the long series by Zach and Triesnecker. From the manuscripts preserved at Paris some corrections have been applicable to the results as printed. To this we may add that Flaugergues' differences of right ascension and declination from his comparison stars are published in the fifth volume of Zach's *Correspondance astronomique*. These observations of Flaugergues' at Viviers, and those made at Paris as they appear in the first folio volume, were reduced several years since by Mr. W. E. Plummer, now of the University observatory, Oxford, and from three very carefully formed normals he deduced a period of revolution about a year and a half shorter than that assigned by Encke in *Zeitschrift für Astronomie*, t. ii., so that the comet may now be expected at any time. At the instance of Prof. Winnecke sweeping ephemerides have been prepared by M. Mahn of Strassburg. It is however M. Schulhof's intention, on the completion of his investigation of the orbit, to furnish observers with ephemerides similar to those which have led to the re-discovery of several lost planets.

An able calculator at Vienna has nearly finished a new discussion of the observations of the comet of 1815 (Olbers' comet), which, according to Bessel's researches, is due at perihelion in February, 1887. This result may be materially changed by the more complete reduction of such series of observations as we possess in their original form, and a recomputation of the perturbations, with more accurate values of the planetary masses than were available at the date of Bessel's work.

CERASKI'S CIRCUMPOLAR VARIABLE STAR.—From the estimated magnitudes of Schwerd and Carrington, and Mr. Knott's epoch of minimum given in NATURE last week, the most probable period appears to be 2·49085d., to be reckoned from 1880, October 23·4672 Greenwich mean time. While the telescope is turned towards Ceraski's star, it may be suggested that Lalande 1013-4 in Cassiopeia should receive attention; at present we have the discordant estimates 10m. and 5m. of Lalande, 1790 September 29, and 1797 November 10 respectively, and 7·7 in the *Durchmusterung;* the star is 6m. on Harding's Atlas, and is not found in Fedorenko's catalogue, or in Argelander's zones; its position for 1880 is in R.A. 0h. 33m. 22s., N.P.D. 38° 46·8'.

THE LONGITUDE OF THE CAPE.—We understand that arrangements are being made for the telegraphic connection of the Royal Observatory, Cape of Good Hope, with Aden, which has already been connected with Greenwich, Mr. Gill taking an active part in the operation. The next desirable work of this kind will be the connection of an Australian observatory with the observatory at Madras, which is well-determined with reference to Greenwich.

GEOGRAPHICAL NOTES

COL. PREJEVALSKY writes from "Houi-de-Tin, plateau of the Hoang-ho, May, 1880." Having packed up and sent off all his collections to Alashan, he left his camp, 25 versts from the town of Donkyr, on March 20, to reach the Hoang-ho, 83 versts from Donkyr. Here the Yellow River turns abruptly from north-east to east, at the small valley of Gomi, inhabited by Tungut cultivators, and forming the extreme point of the habitable lands of the Hoang-ho. The river here is pretty wide, and has a very rapid current. The banks are wooded, with here and there pretty clumps of poplars and weeping willows. The river here is 8,000 feet above sea-level. After ten days at Gomi, Prejevalsky's party resumed their route. From Gomi the journey along the Hoang-ho was very difficult, the banks being deeply cut by steep ravines, which can only be noticed when close upon them. A stream usually flows at the bottom of these ravines, which are bordered by trees and wild arbutus. As soon as ever the party touched the Si-Fan territory a horseman appeared and, telling them they would soon be murdered, disappeared—a threat happily not realised. Indeed the Si-Fan became so reconciled to the presence of the intruders as to sell them butter and sheep. At 130 versts from Gomi they found in the ravines bordering the river vast forests frequented by innumerable birds, especially blue pheasants. The second local rarity was rhubarb, which was met with in prodigious quantities. The old roots of this plant reach colossal proportions. One of these roots, taken at hazard, weighed 26 lb. The mouth of the Churmysh, an affluent of the Hoang-ho, was reached 130 versts below Gomi, by the course of the river. Having examined the country for a distance of 40 versts, Prejevalsky was convinced that it was impossible to cross the enormous chain of mountains which extends along the Yellow River, the summits of which are lost in the clouds. Gaping ravines are met with at every verst, and there is not the least trace of vegetation, and therefore no forage for animals. He decided to return to Gomi. Thence he went to Houi-De, 60 versts on the south bank of the river, and sent his interpreter to Sinin to inform the local authorities that Prejevalsky wished to reach the mountain regions of eternal snow. The Amban of Sinin informed Prejevalsky that it was impossible to allow him to proceed to the Koko-nor, or to penetrate further into Houi-De, where there was a revolt of the Tunguts. Prejevalsky decided to spend the month of June where he was, exploring the fauna and flora, and afterwards go north towards Cheibsen, where he would remain during July, and complete his explorations in the mountains. The weather, he says, was detestable, cold and wet, with the thermometer sometimes 12° below zero C. He had collected 250 specimens of plants, 500 species of birds, and many of fish. The geography of the country traversed had, moreover, been observed and noted, astronomical, barometrical, and thermometrical observations made, and sketches taken of the various types of natives. He doubts much whether the Hoang-ho makes the enormous curve represented in maps; he did not observe any such curve in the 250 versts explored by him. He expected to reach Alashan about August 20.

IN the Geographical Society's *Proceedings* for November Mr. C. R. Markham supplies a brief but lucid account of Lieut. Schwatka's expedition to King William Land, and of the previous state of our knowledge respecting the remains, &c., of the Franklin Expedition, and he arrives at the conclusion that we have gained but little by this last attempt to obtain information beyond that gathered by Sir L. McClintock. Lieut. Schwatka's journey, however, he considers to have been a most remarkable one, and in some respects without a parallel. Dr. Christison follows with a paper descriptive of a journey made some twelve years ago to Central Uruguay. The geographical notes are numerous this month, and furnish much useful information, especially in regard to Africa. Under the head of "Corre-

spondence" we find letters by Adm. R. C. Mayne on a possible communication between Skyring Water, Straits of Magellan, and Smyth's Channel, and by Capt. Alexanderson on the subject of some observations made during a recent voyage along the Loango Coast of West Africa. The maps given this month are of King William Land and the Estancia de San Jorge, Uruguay, with a small inset map of the whole republic.

As we announced last week, the Vienna Geographical Society has issued an appeal for subscriptions for an Austrian expedition, which Dr. Emil Holub has decided on undertaking. Dr. Holub intends crossing the whole length of Africa from south to north. He will start from the Cape of Good Hope and penetrate to the Zambesi, thence explore the Maruthemambunda territory, the watershed district between the Zambesi and the Congo, visit the lake sources of the Congo, and from there through Darfur he will try to reach Egypt. Dr. Holub expects the journey to extend over three years. The expenses, he reckons, will amount to about 50,000 florins, 5000 of which he can himself supply.

LORD ABERDARE will preside at the first meeting of the Geographical Society next Monday evening, when Mr. Jos. Thomson, the Commander of the East African Expedition, who has lately returned from Zanzibar, will give an account of his journey to the Lukuga outlet of Lake Tanganyika, *viâ* the head of Lake Nyassa. Mr. Thomson's paper promises to be unusually interesting, as the country traversed by him was for the most part previously unexplored.

ANOTHER African traveller, Mr. James Stewart, C.E., has just returned to England from Livingstonia, Lake Nyassa. Mr. Stewart, it will be remembered, also crossed the unknown belt of country between Lakes Nyassa and Tanganyika by a different route, for the most part, from Mr. Thomson's, and arrived at the south end of the latter lake only a day or two after him.

IN the November number of their *Chronicle* the London Missionary Society publish a full account of Dr. Southon's interview with Mirambo on the subject of the murder of Messrs. Carter and Cadenhead, and the main facts elicited by him appear to exonerate that chief from any direct share in the unfortunate occurrence. Mohammed, Capt. Carter's servant, succeeded in saving the journals of both Carter and Cadenhead, and all the most important manuscripts and letters of the former.

THE Baptist Missionary Society hope to publish in the December number of their *Herald* an admirable map which they have just received from the Rev. T. J. Comber of their Congo Mission, who has been for some time stationed at San Salvador. It is stated to be very carefully drawn to scale, and to exhibit the many and important discoveries made by the missionaries in their various journeys towards Stanley Pool; it will also show the relative positions of the various towns to Banana, Mboma, San Salvador, Makuta, and other important centres.

THE new *Bulletin* of the Antwerp Geographical Society contains papers by M. Bernardin on the Fiji Islands, their resources, progress, &c., and by Dr. L. Delgeur, vice-president of the Society, on cartography among the ancients.

WE have received from Danzig an excellent little guide-book to that city, with special reference to the scientific and medicinal points of interest of the town and district, compiled from the recent meeting of the German Association. It is a model of its kind, and contains an admirable series of special maps.

DOCTORS ROHLFS AND STECKER have left Suez for Massowah and Abyssinia.

IN the *North American Review* are appearing M. Desiré Charnay's notes of his exploring work in Mexico. The November number contains the third instalment.

KEW GARDENS REPORT

FROM the just-issued "Report on the Progress and Condition of the Royal Gardens at Kew" for 1879 we take the following items:—

Some idea of the magnitude of the destruction caused by the hailstorm of August 3, 1879, may be obtained from the fact that the number of panes broken was 38,649, and the weight of broken glass eighteen tons. The plantations along the Grass Avenue skirting the river have all been greatly improved, very poor specimens removed and replaced by Holm oaks, which will eventually render the avenue practically an evergreen one. This portion of the grounds suffers greatly from the unconsumed smoke of the gas-works and manufactories at Brentford, which is not only most prejudicial to the plants, but so blackens the labels that they become illegible in a few years. Some interesting notes are given on the cultivation of the various kinds of india-rubber. According to Hecht, Levis, and Kahn's Report for 1879, Para rubber (*Hevea*) is still the largest source of supply. The total import into England during the year was 4651 tons. Liverpool received 25 tons of Ceará Scrap rubber and 900 tons of African (*Landolphia*), while London imported 350 tons from Assam (*Ficus elastica*), 250 tons from Borneo (*Willughbeia*), and 550 from Mozambique (*Landolphia*). Considerable attention has been paid at Kew during the past year to the examination of the African Landolphias and Malayan rubber-yielding Willughbeias, and the results will be given in the next report. Additional facts to those contained in the previous Report are given on the introduction of South American species into the Old World. From Singapore Mr. Murton reports:—"The plants of Hevea and Castilloa in the gardens are now large plants, but hitherto propagation from the strong growths they are making seems rather difficult, whereas they used to propagate freely from the weak wood produced while in pots.' Preparations are being made in Burma for the cultivation of Ceará Scrap (*Manihot glaziovii*), while Dr. King reports that the Ceará rubber promises to grow well in Calcutta; seeds have been distributed to various parts of India, and the plant seems to thrive well in Upper India. Singapore does not seem to suit Ceará Scrap, according to Mr. Murton, while at Zanzibar it yields seed most abundantly, but the seeds are slow to germinate. At Zanzibar the Pará rubber is a less quick grower than the Ceará and does not branch. At Mergui eight Pará trees, the survivors of a batch of seedlings received from Dr. King in 1877, continue to do well in the office compound. At Calcutta, according to Dr. King, Pará rubber continues to be as disappointing as ever; he believes it is useless to try it anywhere except in the south of Burma or the Andamans, and perhaps in Malabar. Mr. Jenman reports that the atmospheric conditions in Jamaica appear favourably adapted to the Pará rubber. Equally important information is given as to the cultivation of mahogany in the Old World. On this the Report says: "This may now be regarded as an accepted success. The tree grows well in many parts of India and in Ceylon, and in the former there is a local demand for the wood. In this country new uses are found for it, one of the most recent being for the linings and panellings of railway carriages instead of teak, which is now exclusively used for ship-building. It is not easy to see any valid arguments against the cultivation of a tree the timber of which is of admitted excellence for a variety of purposes and the growth of which is apparently attended with little difficulty. As late as 1876 the Government of Bengal was adverse to mahogany planting. This policy has now, however, been modified, and in his report for 1878–79 Dr. Brandis, the Inspector-General of Forests, reports: 'Of the exotic trees which are cultivated by way of experiment mahogany is the most important, and its success seems not improbable, though it is too early yet to form final conclusions upon the subject.' Mahogany is also cultivated as an experiment in Burma and the Chittagong district of Bengal. The tree is known to thrive well near Calcutta, and every effort should be made to cultivate it in those forest districts where climate and other circumstances are favourable." Experiments are being made in Queensland, and favourable reports come from Saharunpore and Singapore. Some curious notes are contained in the Report on Chestnut Flour: "We are indebted to Mr. D. E. Colnaghi, H.B.M.'s Consul at Florence, for specimens of the dried chestnuts, flours, and *necci* (the cakes made from them), which are so important an article of subsistence in the Apennines. The collection of the specimens for Kew was due to the kindness of Dr. L. Bacci of Castigliano, in the mountains of Pistoja. The fresh chestnuts are dried, or rather roasted, for three days and nights in a *seccatoio*, or drying room, on a latticed floor covering a chamber in which a fire is lighted. The husk is then easily removable, and the kernel is ready to be ground into flour, which is of a pinkish colour. This is mixed to the consistence of cream with water, and poured on fresh chestnut leaves to be baked into small circular cakes, *necci*, between heated stones. The collection having been divided between the museum of the Royal Gardens and the Food Collection, Bethnal Green, Prof. Church, who has charge of the latter, has obligingly furnished us with the following analysis of the flour:—

Moisture	14·0
Oil or fat	2·0
Proteids	8·5
Starch	29·2
Dextrin and soluble starch	22·9
Sugar	17·5
Cellulose, &c.	3·3
Ash	2·6
	100·0

The cakes were found to contain only 6·7 per cent. of proteids, with 3·4 per cent. of flour. The large amount of dextrin is due to the high temperature to which the chestnuts are subjected in the process of drying. Prof. Church thinks that chestnut-flour ought to be of easy digestibility, and a suitable children's food, considering that it contains over 40 per cent. of nutritious matters soluble in pure water. The Museum of the Royal Gardens is indebted to Mr. George Maw for a specimen of a product used, according to the Rev. Wentworth Webster, who procured it, as tea in the Basses Pyrenées in France, and on the Spanish side of the Pyrenées in Navarre. It was found to consist of the dried shoots of a species of *Lithospermum*, which was identified with probability as *L. officinale*." Mr. Noble advocates the cultivation of rye-straw (*Secale cereale*) as a paper material, not inferior to esparto. Mr. W. L. Booker, H.M.'s Consul at San Francisco, sent some specimens of a scented wood from the highlands of Mexico, known as Lin-a-Loa, and which has been identified with a wood already in the Kew Museum, and which appears to be yielded by a species of *Bursera*. Further material in the shape of dried specimens, with both fruit and flowers, is much to be desired for the purpose of ascertaining definitely the tree which produces it. The name Lin-a-Loa is clearly a corruption of Lign Aloës, which has been identified with *Aquilaria agallocha*, otherwise known as eaglewood (Kew Report, 1878, p. 36). This is however a tree confined to the Old World, and the Mexican one has no connection with it. The wood of the latter is imported into this country for manufacture into perfumery, a fragrant oil known as otto of linaloe being distilled from it. On the interesting Chinese timber-tree known as the Nan-mu-tree, and referred to in the Report for 1877, some information has been obtained from Mr. Baber:—"Two days' journey south-east of Chungking in Szechuen I found several specimens of about a foot in diameter, one of them having a straight branchless trunk of 100 feet in height, with the branches and foliage rising 25 feet above that; another had 70 feet of bare straight stem, and 90 feet of total altitude. Although the trunks are branchless, yet in many cases they send out shoots resembling saplings, which rise parallel with the trunk. The wood is white and close-grained, and I do not believe that the pillars at the Ming tombs near Peking are of this wood. They look more like true teak. I have seen some much larger trees than the above, some two feet and more in diameter, straight and of great altitude. They are used in Szechuen for bridge work." Eventually, through the instrumentality of Père Vincot, who resides at Chungking, flowering specimens were transmitted to the Kew Herbarium. From these a figure has been prepared, and they entirely confirm the previous identification of the tree by Prof. Oliver (from the leaves alone) as a near ally of *Phœbe pallida* (one of the laurel family). The genus *Phœbe* is now merged in *Persea*, and Prof. Oliver has described the Nan-mu under the name of *Persea nan-mu*, distinguishing it from *Persea* (*Phœbe*) *pallida* "chiefly in stature, in the form of the acumen of the leaves and the character of the indumentum." On a block of Pai-chai wood sent by Mr. W. M. Cooper, H.B.M.'s Consul at Ningpo, Mr. R. J. Scott reports:—"The most striking quality I have observed in this wood is its capacity for retaining water and the facility with which it surrenders it. This section, which represents one-tenth of the original piece, weighed 3 lbs. 4½ ozs. At the end of twenty-one days it had lost 1 lb. 6¾ ozs. in an unheated chamber. At the end of another fourteen days, in a much elevated temperature, it only lost ¼ oz. In its present state of reduced bulk its weight is 1 lb. 10 ozs. It is not at all likely to supersede box; but it may be fit for coarser work than that for which box is necessary." The principal researches conducted in the laboratory during the past year have been those of Mr. Marshall Ward, on the development of the embryo-sac, published in the *Journal* of the Linnean Society, vol. xvii. pp. 519–546; Prof. Church, continued investigation on albinism in leaves, published in the *Journal* of the Chemical Society, January, 1880. The laboratory has also been employed for the experimental demonstrations given to the *employés* of the Royal Gardens, and for the examination of the University of London for the degree of Doctor of Science in the subject of physiological botany.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The examinations for the degree of Bachelor of Medicine will commence in the medical department of the Museum as follows:—

The First (Scientific) Examination) November 29.
The Second (Final) Examination, December 6.

Candidates for either of these examinations, and candidates for the certificate in Preventive Medicine and Public Health are requested to send in their names on or before November 15 to the Regius Professor of Medicine at the Museum.

The University of Oxford Commissioners have given notice that all new scholarships and exhibitions granted by the Colleges shall be subject to the provisions of any new statutes which may be made by the Commissioners in relation to the length of tenure and emoluments of such scholarships and exhibitions.

The University Commissioners at present sitting have forwarded to the Hebdomadal Council six proposed statutes which they contemplate making, subject to any representation which they may receive from the Council on the appointment and duties of University Professors and Readers. The proposed statutes include certain general regulations applicable to the whole Professoriate. Each Professor must reside six months in each year between October 1 and the ensuing July 1. Each Professor, besides his regular course of lectures, must give one public lecture every year. Each Professor must give private instruction to students in matters relevant to the subject of his lectures, and must examine the students who have attended his lectures at the end of each course.

The following are the particular regulations applicable to the Savilian Professor of Astronomy, the Professor of Experimental Philosophy, the Waynflete Professor of Chemistry, the Linacre Professor of Human and Comparative Anatomy, the Waynflete Professor of Physiology, and the Wykeham Professor of Physics. Section 7 relates to the three proposed new professorships.

(1) The Professor shall deliver one course of fourteen lectures at least in each of two out of the three University terms (Easter and Trinity Terms being counted as one); every course shall extend over seven weeks at least, and not fewer than two lectures shall be delivered in each week.

(2) He shall be ready to give the private instruction required by the General Regulations on two days in each week in which he lectures, and during one hour at least on each of such days.

(3) The laboratory under the charge of each Professor, and, in the case of the Savilian Professor of Astronomy, the University Observatory, shall be open for eight weeks in each term (Easter and Trinity Terms being counted as one), and at such other times, and for such hours, as the University may by statute determine.

Students shall be admitted to the University Observatory and to the laboratory under the charge of each Professor, upon such conditions as the University shall from time to time by statute determine, and upon the terms of paying such fees, not exceeding such amount as may be fixed by any statute of the University in force for the time being, as the Professor may from time to time require.

(4) Except for some grave reason to be approved by the Vice-Chancellor, the Professor shall, for seven weeks in each term (Easter and Trinity Terms being counted as one), and during some part of three days in each week, be ready to give instruction in the subjects of his Chair to such students as shall have been admitted to the laboratory under his charge (or, in the case of the Savilian Professor of Astronomy, to the University Observatory); and such instruction shall be given in the laboratory or observatory (as the case may be) or in some class-room connected therewith.

(5) The Professor shall also, at the close of each term, inform any college which may request him to do so as to the regularity of attendance and the proficiency of the students belonging to such college who have been admitted into the laboratory or observatory under his charge, and shall give like information, if requested, to the delegates of students not attached to any college or hall.

The Particular Regulations next following shall be applic-

able to the several Professors named in them respectively (that is to say):

(1) The Savilian Professor of Astronomy shall have the charge of the University Observatory, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(2) The Professor of Experimental Philosophy shall have the charge of the Clarendon Laboratory, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(3) The Waynflete Professor of Chemistry shall have the charge of the Chemical Laboratories in the University Museum, or such part thereof as the University may by statute assign to him, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(4) The Linacre Professor of Human and Comparative Anatomy shall have the charge of the Anatomical and Ethnological Collections and the Anatomical Laboratories in the University Museum, or such part thereof as the University may by statute assign to him; and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(5) The Professor of Botany and Rural Economy shall have the charge and supervision of the Botanical Gardens and Botanical Collections belonging to the University; and it shall be part of his duty to make such Gardens and Collections accessible to, and available for, the instruction of students attending his lectures.

(6) The Professors of Geology and Mineralogy respectively shall have the charge and supervision of the Geological and Palæontological Collections, and of the Mineralogical Collection, belonging to the University; and it shall be part of their duties to make such collections respectively accessible to, and available for the instruction of, students attending their lectures.

(7) The Professor of Classical Archæology,
The Wykeham Professor of Physics, and
The Waynflete Professor of Physiology,

shall, in like manner, if the University by Statute shall think fit to charge them therewith, undertake the charge of any collections or laboratories connected with the subjects of their respective Chairs, which the University may from time to time assign to them, and shall have similar duties in respect thereof.

(8) The several Professors named in the foregoing particular regulations shall in the performance of the duties committed to them by such regulations be subject to the statutes of the University for the time being in force in that behalf.

This Statute is proposed to be made by the University of Oxford Commissioners under the Universities of Oxford and Cambridge Act, 1877, for the University.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, October 26.—M. Wurtz in the chair.—The following papers were read:—On attenuation of the virus of chicken-cholera, by M. Pasteur. If the most virulent virus (to be got from a fowl which has died of the chronic form of the disease) be taken and successive cultivations made of it in the pure state, in bouillon of fowl's muscles, the interval of time between one sowing and another is found to affect the virulence. With intervals up to one month, six weeks, or two months, no change of virulence is noted, but as the interval is enlarged the virus is found to become weaker. The attenuation does not take place with mathematical regularity. No change can be detected in the microscopic organisms to account for the changes in its power. But M. Pasteur shows by experiments (in which some bouillon, to which a little strong virus had been added, was inclosed and kept some time in sealed tubes) that it is probably the oxygen of the air that attenuates the virulence. May it not then also affect other kinds of virus?—Experimental study of the action of the organism of sheep, more or less refractory to splenic fever, on the infectious agent; what becomes of specific microbia introduced directly into the circulation by large transfusions of anthracoid blood, by M. Chauveau. After such transfusion into animals whose resistance to the disease is considerable and strengthener by preventive inoculation, the bacterian rods soon disappear from the blood (in a few hours one cannot find them). They are not destroyed, however, but are arrested in the capillary system of the lungs and of other parenchymatous organs, where they may be found with retained vitality when the transfusion has been rapidly fatal. When the animal survives more than three days the bacteria disappear from the lung and the spleen (as well as the blood), and health may be regained. One region alone proves favourable to maintenance and development of the bacterian life, viz., the surface of the brain (pia mater), and the development there has quite special characters (elongation and inflexion of the rods and appearance of spores), resembling those which belong to artificial cultivations. The infectious activity of these bacteria of the pia mater is considerable.—On linear differential equations, by M. Appell.—The Secretary announced the opening of a subscription for erection of a monument to the memory of Spallanzani in his native town.—On the class of linear differential equations, with rational coefficients, the solution of which depends on the quadrature of an algebraic product which contains no other irrationality than the square root of an entire and rational polynome, by M. Dillner.—Photography of the nebula of Orion, by Prof. Draper.—Application of selenium to the construction of a photo-electric regulator of heat for the burning in of stained glass windows, by M. Germain. As far as possible from the muffle furnace is placed a dark chamber closed by a parabolic reflector, the focus of which is in the axial line of the telescope commonly used. At this focus is a ball of selenium between two cups of brass, leaving a zone of selenium visible. One cup is connected by German silver wire to a thermo-electric pile (of thirty elements), adapted for strong heat and exposed to that of the muffle, and the pile is connected (by the other poles of its elements) to the side of a stoppered porous vessel filled with water, ensuring a sensibly constant temperature on that side. The thermo-electric current increases with the temperature, and while the part of the muffle covered by the telescope remains dark, the selenium does not effectively alter in resistance, but when a cherry-red tint is reached (indicating time to stop), the resistance of the selenium is reduced about a fourth. The current gains strength and sounds a bell, or affects a system whereby the fuel is diverted. (With the pile is connected a galvanometer, a condenser, and other secondary arrangements.)—On some modifications undergone by glass, by M. Salleron. He calls attention to the corrosion, deformation, and fracture of areometers used in sugar-works which treat molasses by osmose; where the instruments are kept several days in a liquid at 95°, of density, 1014 (2° B), and containing sugar 115 gr., ash 91 gr.; total 206 gr. per litre. The ash consists of chloride of potassium and organic salts of potash. The cracks are all more or less spiral in form.—Influence of light on germination, by M. Panchon. He measured the quantities of oxygen absorbed during germination by identical lots of seeds. Light (he finds) accelerates the absorption in a constant manner; the advantage in favour of light being from a fourth to a third of the quantity absorbed in darkness. The degree of illumination is relative to the quantity absorbed. The respiratory acceleration in seeds illuminated by day persists for several hours in the darkness. The accelerative influence of light is more intense at low temperatures.

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